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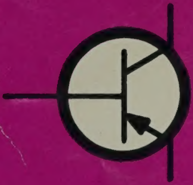
ELECTRONIC CIRCUITS HANDBOOK

VOLUME II

by tom kneitel, K2AES



FOR ALL

HAMS CB'ers SWL's

EXPERIMENTERS

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ELECTRONIC
PROJECTS

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Technical
Series

Electronic Circuits Handbook

VOLUME II

Edited by Tom Kneitel, K2AES

FOR THE HAM, CB and SWL EXPERIMENTER

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Electronic Circuits Handbook

VOLUME II

Edited by Tom Kneitel, K2AES

FOR ALL HAMS CB'ers SWL's EXPERIMENTERS

COWAN PUBLISHING CORP.
14 VANDERVENTER AVE. PORT WASHINGTON, N. Y.

Dedicated to my grandfather, Max Fleischer

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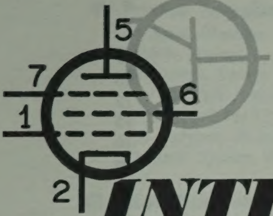


INTRODUCTION

When the "original" edition of ELECTRONIC CIRCUITS HANDBOOK came out a while back, we had no idea that there would be such a fantastic demand for compilations of simple, easy-to-knock-together circuits.

This edition, Volume II, contains an entirely new assortment of circuits and is intended as a follow up to the original, to satisfy the hunger of those who "dug" the earlier book. We have added a number of VHF circuits this time.

Either book can stand alone as the source of many handy little gadgets around a radio shack, and together they form a set of books which can be called upon to come up with the answer to just about any device you might ever need.

The author wishes to express his thanks to his merry little band of enthusiastic elves who did all of the production work on the book. This includes itty-bitty Susan Henriksen and our gal with the magic IBM typewriter, Lilia Neira.

Tom Kneitel, K2AES

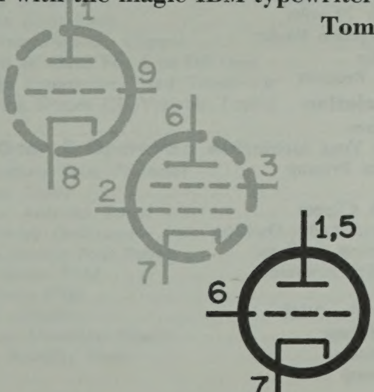


TABLE OF CONTENTS

I. Theory & Construction **9**
Slug Tuned Coils 10
Meet The Capacitor 12
Soldering, Do It Right 15
Meet The Resistor 16

II. Transmitters **19**
1 Tube CW Transmitter 20
1 Tube For 8 Watts 20
16 Watt "Rock Crusher" For 40 and 80 21
22 Watts on 40 and 80 23
15 Watts Mobile on 75 23
1 KW Linear 10 to 80 26
11 Meter "Sputnik" 28

III. Receivers & Accessories **31**
1 Tube 40 Meter Regen 32
10 Meter Super-Regen 33
40/80 Transistorized Converter 33
10 Thru 40 Mobile Converter 34
15 Meter Converter 35
10 Meter Mobile Converter 35
10 to 80 Preselector 36
Broadband Nuvistor Preselector 36
Cascode Preselector For 15 and 20 37
CW/SSB Noise Limiter 37
SSB Detector For Any Receiver 38
Transistorized Squelch 38
1 Tube Squelch 38
Q-Multiplier For 1400 kc IF 38
Q-Mulitplier For 1500-1650 kc IF 39
T-Notch Filter For 455 kc IF 39
T-Notch Filter For BC-453 39
100 kc Crystal Calibrator 39
Another 100 kc Crystal Calibrator 40
Two Set Coupler For 10 Thru 80 40
"Static Smasher" Noise Limiter 41
"Signal Snatcher" Nuvistor Preselector 42
Tune Up A La 1629 Magic Eye Tube 44
CB Converter for 12 volts 45
The "Sniffer" Direction Finder 46
Razor Blade Radio 47
1 Transistor SW Receiver 48

IV. Audio & Modulation **49**
Simple Mike Mixer 50
More Audio For Your Mobile 50
1 Transistor Mike Preamp 50
Speech Clipper 51
Transistor Speech Clipper 51
1 kc Transistorized Audio Oscilator 51
1 kc SSB Alignment Oscilator 52
2 Transistor Audio Generator 52
SSB Monitor 52
Phase Modulator For VHF 53
Screen Grid Modulator 53
1 Tube Mike Booster 54
Poor Man's Preamp 54

The "Band Blaster" Preamp 55

V. Power Supplies **57**

12 Volt Charger 58
Mobile Inverter 58
Beginner's Power Supply 59
6.3/90 Volt Power Supply 59
6/12/150/250/325 V. Power Supply 59
All Purpose Power Supply 60
Control System For Monitoring Voltage 60

VI. Modifications **61**

Noise Limiter For Drake 2A 62
32S1 and 75A4 Sidetone 62
32V2 Conversion For 4 mc MARS 62
32V-Series TVI Cure 62
75A4 Modifications 62
More 75A4 Modifications 63
DX-40 On 6 Meters 63
DX-60 Push-To-Talk Circuit 64
DX-100 Output Indicator 64
DX-100 or Viking QRP on 160 65
HQ-100 Improved 65
HQ-170 Frequency Stability 65
HT-32 or 32A Modifications 66
HT-33A Linear Modifications 66
HT-37 Tuning Improvements 67
HT-37 Automatic Load Control 67
HX-10 Marauder Key-Click Filter 67
KWM Modifications 67
KWM-2 Independent Receiver Control 68
KWM-2 on AM 68
Decreased S-Meter Sensitivity 68
NCX-3 Modifications 69
NCX 3 CW Monitor 69
SB-10 on 6 Meters 70
T-60 Spotting 71
TX-1 VFO Improvement 71
VFO-62 Increased Output 71
VFO-62 Stability 71
Convert Johnson 5 Channel CB Unit to 10 Channels 71
Add an S-Meter 73
Receiver Drift Cure 74
CB Preamp/Speech Clipper 74
Untuned IF Stage For 8-10 DB Gain 76
Variable Tuning for Fixed Tuned CB 76
Improving Gonset CB Variable Tuning 77

VII. Test Gear & Operating Aids **79**

Transmitting Tube Protector 80
Antenna Tuner 80
Another Antenna Tuner 80
VHF Noise Generator 80
Peak & Peak-to-Peak Probe 81
1 Transistor FSM 81
High Gain FSM 81
Crystal Checker 82
Checking Matching Diodes 83
Silicon Rectifier Tester 83

Transistor DC Voltmeter 83
Keying Relay and Monitor 84
Code Practice Oscillator 84
Easy Code Practice Oscillator 84
Tube Code Practice Oscillator 85
Self Powered CW Monitor 85
Schmitt Trigger 85
10 Minute Minder 86
Phone Patch 86
Mobile Access Cutoff Circuit 87
Variable-Heat Soldering Iron 87
Built-In Modulation Monitor 88
$5 Field Strength Meter 89
Modulation Checker 89
Tuning Meter Circuit 90
TVI Detection Unit 91

VIII. VHF Transmitters 93
6 Meter Walkie Talkie 94
1 Tube on 6 95
10 Watts on 6 95
12 Watts on 6 96
15 Compact Watts on 6 98
15 Watt 6 Meter Linear 98
25 Watt 6 Meter Linear 99
2 Meter "Oscar" Beacon 99
Simple 2 Meter Transmitter 101
20 Watts on 2 102
2 Meter Kilowatt 103
2 Meter Transceiver 104
220 mc Transmitter/Exciter 106
60 Watts on 220 106
144/435 mc Tripler 107
432 mc Transmitter 108
440 mc TV Transmitter 109
1296 mc Crystal Oscillator 110
1296 mc Cavity Amplifier 110

IX. VHF Receivers, Converters, Preselectors 113
6 Meter Receiver 114
6 Meter Transistor Converter 114
Overload-Proof Converter For 6 114
1 Tube Compactron Converter For 6 116
6 Meter Double Conversion Converter 117
Transistor Preamp For 6 118
Nuvistor Preselector For 6 118
2 Nuvistor Preselector For 6 118
6 Meter Hash Filter 118
2/6 Meter Converter 119
Miniature 2 Meter Receiver 119
No-Clobber 2 Meter Converter 120
2 Meter Nuvistor Preselector 121
417A 2 Meter Preselector 122
416B 2 Meter Preselector 122
Preselector with Power Supply 122
7788 2 Meter Preselector 123
430 mc Converter 124
430 mc Transistor Preselector 125

THEORY

&

CONSTRUCTION

Slug Tuned Coils

Anyone who has been exposed to ham radio for any length of time, is familiar with the slug-tuned coil. Familiar, perhaps, in the knowledge of what one looks like; but I'll venture to predict that most average hams have a lot to learn about what makes a slug-tuned coil behave the way it does.

My own search for knowledge began with a deep sense of frustration. I'm an avid reader of practically every ham publication, and my junk box never approaches that "well-stocked" level simply because I'm always building something. Sometimes they work and sometimes they don't, and as often as not the villain is the subject of this little treatise—the slug-tuned coil.

An author will specify a ⅜" slug-tuned form, No. 168B4956, and even though we are blessed here in town with one of the pioneer electronic supply houses in the United States—they never heard of it. So I dig into the trusty junk box and come up with a ⅜" slug-tuned form that looks like the author's illustration. Will it work? You never know until you try, and I'll tell you right now you probably won't be any better off in this same situation after reading the rest of this article—only you might know why it *didn't* work.

Tuning slugs or ferrite cores are made by a number of manufacturers to different specifications. They are blends of various powdered-iron materials with other metallic oxides added, and they are molded and sintered at temperatures up to 1200° centigrade to create desired mechanical and magnetic characteristics.

The unit for measuring magnetic flux density is *Gauss,* and the measure of applied magnetizing force is the *Oersted*. The characteristic of a given core of specific formulation is defined by the relation of flux density to applied force, plus the effects of frequency and temperature upon these properties.

The term permeability (μ_o) is used to indicate the over-all magnetic properties of a given slug (measured in Gauss), and among the magnetic specifications listed for a given grade of core or slug material, you will find such things as initial permeability, maximum permeability, incremental permeability, and a lot of other specifications only a design engineer would need to understand.

What is important to remember at this time is that the iron core in a slug-tuned form is designed for a specific job, and if given a chance to do the job it was designed to do it can:

1. Increase the *Q* of a small coil, or in other words, its selective properties.

2. Increase the inductance, thereby permitting use of smaller coils than would be possible with air-core coils alone.

3. Act as a tuning device. In general, the higher the permeability (μ) the more effect the slug will have upon the inductance and hence the tuning range.

On the other hand, the introduction of a slug into a coil can, if not properly chosen, actually lowers the *Q* of the system, and the right amount of permeability to do the job is the problem which has to be successfully solved, for best results.

To observe the characteristics of various cores, examine fig. 1. Shown is a graph, supplied by Stackpole Carbon Company, plotting *Q versus* frequency for various Cermag brand ferromagnetic cores.

On this chart, the various grades of Ceramag are graphically illustrated in relation to frequency. The numbers represent initial permeability ($\mu_o = 1000$ Gauss in the case of Ceramag No. 27). You can easily imagine the results you would get if you reached into your well-stocked junk box and pulled out a coil form with the

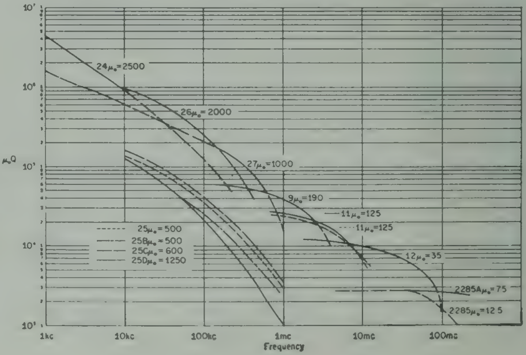


Fig. 1—Plot of **MERIT FACTOR** *versus* **FREQUENCY** for Ceramag cores, a product of Stackpole Carbon Company. The data was obtained under toroidal conditions with sinusoidal waveforms and only material losses are shown. The μ_o is constant over the frequency range shown and only the Q changes.

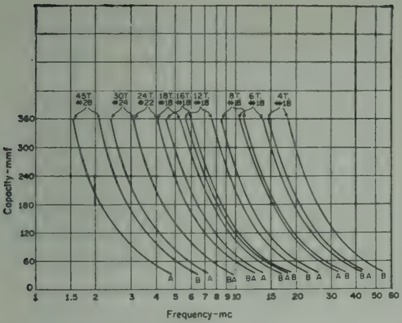


Fig. 2—Frequency—Capacity chart for the National XR-50 form. The *A* curves are with the cores set for maximum inductance and the *B* curves are for minimum inductance.

characteristics of their No. 27, and proceeded to wind a 50 mc coil on it. Too much permeability—too many losses—too low a *Q*; no merit factor, in other words.

Coding

At this point we all should begin to wonder why the manufacturers of slug-tuned coil forms don't package construction data such as optimum frequency range in with their products, instead of simply sealing up one No. 168B4956 form in a poly bag, and letting you guess the rest.

Well, all is not quite lost because there is some help available in a limited way from color codes used by a few manufacturers. If you pick up a form, and it has a dab of one of the following colors on the end of the slug, you can get a fair idea of the frequency range over which it might be effective from this data.

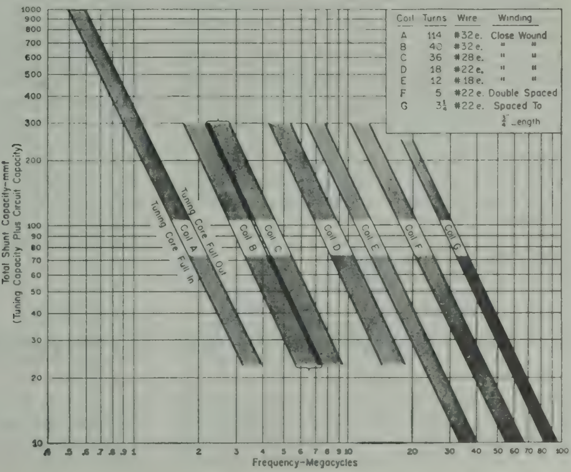
Yellow — Up to 1.5 mc
Red — 1 mc to about 20 mc
Purple — 10 mc to 30 mc
Blue — 10 mc to 40-50 mc
Green — 20 mc to 50 mc
White — 50 mc and up

This isn't an ironclad code, and purple slug from one manufacturer might be good at 40 mc while another make might only go to 20 mc. It is a guide, however, providing you *can* find a color code.

Published Data

Another approach is to use known published data on coil forms. Undoubtedly, one of the reasons for the popularity of the National Radio XR-50 form was the inductance vs. turns chart they supplied with it. We have reproduced this chart (fig. 2) because it apparently isn't generally available, and any home-brew artist could do a lot worse than use this data if he is working in the ranges of from 3 to 30 mc. As you can see, this one just about does it except for v.h.f., by using a combination of different wire sizes, number of turns, and capacity. Strangely, this is the only data of this sort apparently available on National forms.

J. W. Miller Company manufactures a number of ready-made coils and also offers coil forms. No frequency-capacity charts are available on these forms but from the data sheets packed with them it can be determined that good results up to 8 mc or so can be obtained with their No. 4400 coil form, and from 2.5 mc up to 25 mc with their No. 4500 with red marked core.



Coil	Turns	Wire	Winding
A	114	#32 e.	Close Wound
B	40	#32 e.	" "
C	36	#28 e.	" "
D	18	#22 e.	" "
E	12	#18 e.	" "
F	5	#22 e.	Double Spaced
G	$3\frac{1}{4}$	#22 e.	Spaced To $\frac{3}{4}$" Length

Fig. 3—Chart used to determine windings and parallel capacity value required to tune from 0.5 mc to 95 mc with Millen No. 74001 form.

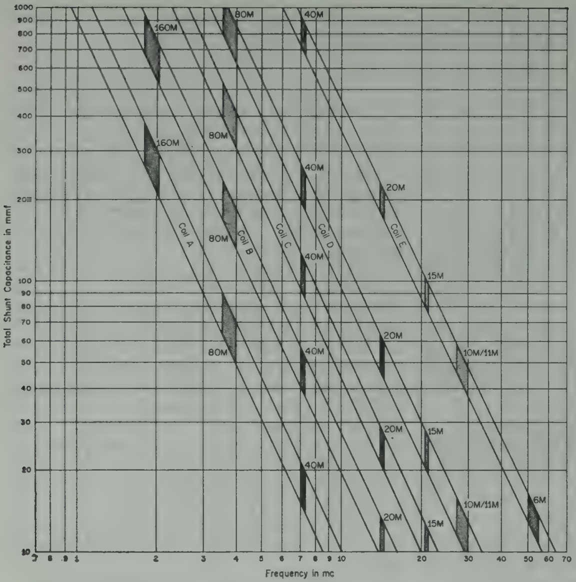


Fig. 4—Data needed for the use of Millen coil form #69046 is given above. The two lines, X and Y, for each coil represents the slug full in (X) and slug full out (Y). The Total Shunt Capacitance represents the tuning capacity plus the circuit capacity.

Coil A—62t. #28e., close spaced.
Coil B—40t. #24e., close spaced.
Coil C—28t. #20e., close spaced.
Coil D—18t. #18e., close spaced.
Coil E—10t. #18e., spaced to fit between clips.

James Millen, another major manufacturer of coil forms, has extensive engineering data on most of their forms. Their "Cadillac" coil form is the No. 74001, which is a completely shielded form with an octal base. The slug is tuned from below the octal socket as the shaft extends through the keyway. With various combinations of shunt capacity, and by also varying the wire size and number of turns, this form can be made to tune from 0.5 to 95 mc. This chart is shown in fig. 3.

In addition to the shielded coil form, Millen makes a line of ceramic forms from 3/16" to ½" in diameter and with winding space from 11/32" to 1½". Data on their No. 69046 coil form is shown in fig. 4 with the ham bands blocked in. This form will cover from 160 meters all the way up to 6 meters with, of course, various combinations of capacitance and wire sizes and numbers of turns.

For the v.h.f. crowd, all is not lost either. Notice that we hit 6 meters on that last chart. Take the same coil form and use a copper slug, and it's Millen's form No. 69045, which will reach 2 meters or 6 meters with three turns of No. 14 tinned and spaced to fit between the clips. Of course, to tune 2 meters you only need about 10 mmf of capacity, while it takes around 80 mmf to tune 6 with this combination.

National also makes v.h.f. coil forms, and those with brass slugs, such as their XR-91, will hit 2 meters. Unfortunately, no chart data seems to be available so the capacitance and wire turns data is cut and try. I have substituted this form with good results, however, on 2 meter construction projects when I couldn't buy the one specified.

Cores made of non-ferrous materials affect the inductance of a coil in opposite fashion to those of iron. Insertion of a brass core, for example, tends to decrease the inductance rather than increase it. Such cores, however, result in a better Q at v.h.f. frequencies above 50 mc as a general rule.

Meet The Capacitor

The physics of a capacitor or condenser—call it what you will—are well known. Any pair of electrical conductors having their surfaces relatively close together and separated by a dielectric (insulating) material forms a capacitor that will store electrical charge when a difference in potential is applied across them. When the conductors are in the form of parallel plates, close together and of large area, the capacity of the capacitor is given by the formula:

$$C = 2.25\ \frac{KA}{t}\ 10^{-7} \text{ microfarads}$$

where:

K = Dielectric Constant
A = Area of one side of either plate, sq. in.
t = Spacing between plates, in.
(1 microfarad = 1×10^{-6} Farads)

This familiar equation shows that the capacity is directly proportional to the area and the dielectric constant and inversely proportional to the spacing between plates. The dielectric constant is defined as the ratio of the capacitance of a capacitor using a specific dielectric material to the capacitance of the same capacitor having a vacuum as the dielectric. Obviously, a capacitor may be increased in capacity either by decreasing the spacing or by increasing the area of the plates or the dielectric constant.

TEMPERATURE AND VOLTAGE CHARACTERISTICS

Since space is of paramount importance in most electronic equipment, it would seem at first glance that capacitors might very well have minute spacings between plates to achieve large capacities in small "packages"; however, voltage breakdown possibilities between plates must be considered. To prevent voltage arcing between plates, any dielectric material must of necessity have good "dielectric strength" if small spacings and high capacities are to be achieved.

The actual materials used for dielectrics in practical fixed capacitors vary in dielectric constant from about 7 for mica to several thousand for certain ceramics. For the same physical dimensions, a high dielectric capacitor may have many hundred times the capacity of a mechanically similar mica unit, although the former may *not* maintain a constant capacity over wide ambient temperature changes. The "temperature coefficient of capacitance" or the change in capacity with temperature, generally becomes worse as the dielectric constant K increases.

There are some ceramic dielectrics containing the mineral rutile which exhibit certain useful temperature coefficients. These substances, when mixed in certain proportions, have negative temperature coefficients (capacity varies inversely with the temperature) when K is larger than 21, zero when $K = 21$, and positive coefficients when K is less than 21. A coefficient is usually expressed as a certain number of parts per million parts per ° Centigrade (p/m/° C) in temperature and is preceded by a sign indicating positive or negative characteristic. Thus, a 100 micromicrofarad capacitor having a temperature coefficient of − 220 parts/million/° C will decrease in capacity 0.022 micromicrofarads ($\mu\mu$f) per degree Centigrade increase in temperature, and vice versa. The calculation is done as follows:

$$\Delta C = \frac{100 \times 10^{-12} \times (-220)}{10^{6}\ ^\circ C} = -0.22 \times 10^{-12}$$

$$\text{farads}/^\circ C = -0.22\ \mu\mu f/^\circ C$$

Such a capacitor might very well be used in some critically tuned circuit where a decrease in capacitance with increasing temperature is needed associated inductor due to heating of the wire.

Mica finds greatest use as a dielectric material when excellent capacitance stability over wide ranges of temperature is expected. In smaller capacity values, generally those under 200 $\mu\mu$f, zero coefficient ceramic units are capable of performing equally well. Unfortunately, small size zero coefficient ceramic capacitors cannot readily be made having capacity values exceeding several hundred $\mu\mu$f, since they are essentially single layer capacitors while mica units invariably consist of many layers of alternate conductor plates and mica dielectric sheets.

POWER FACTORS

A perfect capacitor would hold a charge infinitely and thus would have zero per cent power factor. That is, the impressed AC voltage would lead the current through the capacitor by precisely 90°. In practice, however, this is not quite the case. Dielectrics are never absolutely perfect insulators, and further, some corona and leakage resistance effects are always present in varying degrees depending upon the types. A word of caution is in order concerning high quality capacitors of large capacity values. These items may hold a death-dealing charge for long periods of time, and care must be taken to prevent accidental contact with both plates or terminals unless they are first shorted together through a small current limiting resistor.

When using a capacitor in a VHF tuned circuit, it is most desirable to use one having the best possible power factor, i.e. the lowest in per cent, if high Q is to be maintained. At 1 megacycle, mica and certain ceramic capacitors have power factors of about 0.02% a figure which insures excellent circuit performance.

It should be mentioned that power factor worsens with increasing frequency, and that, at higher frequencies, increasing lead and contact resistances of the capacitor also tend to add additional circuit losses.

Ordinary mica capacitors are made by piling up alternate sheets of copper foil and mica, after which external leads are connected to the correct internal jumpers between sheets. By plating the sheets or the mica itself with a thin film of pure silver, the over-all resistance of the capacitor may be appreciably reduced with a noticeable gain in high frequency performance. These capacitors are known as "silver micas" and are available at extra cost. Ceramic condensers, on the other hand, are usually made by spraying silver paint on opposite sides of a ceramic dielectric, after which the silver is firmly bonded by firing at high temperatures. Thus, these components have inherently good power factor, excellent mechanical stability, and are also extremely suitable for very high frequency applications.

In the discussion which follows, mica and ceramic capacitors will be treated individually with emphasis on the selection of the correct type for an application. Some notes on paper capacitors will also be introduced.

MICA CAPACITORS

Mica capacitors find use in circuits where a high order of stability is desired. Depending upon the quality of a particular capacitor, the temperature coefficient of capacitance will vary from about ± 200 parts/million/° C for the average good varieties to 0 to– 50 p/m/° C for the best available. The size increases very appreciably as the temperature coefficient requirements are tightened; however, this is common with ceramics as well. Long time capacitance stability of the mica capacitor appreciably betters as the temperature coefficient of capacitance is reduced, since the greater volume used tends to nullify temperature effects.

Small micas from 6,200 μμf down are rated at 500 DC working volts, while those above have 300-volt ratings. These figures apply only to the small receiving types, since it is possible to obtain micas in larger cases for almost any working voltage desired. The voltage ratings for AC depend upon the frequency involved. A particular 1,000 μμf mica capacitor rated at 10,000 volts at 1 kilocycle, for example, has a breakdown voltage of only 178 volts at 10 megacycles, a fact often overlooked.

The minimum value generally available for micas is 5 μμf while the maximum for small receiving types is 10,000 μμf or 0.01 μf. This wide range is sufficient to meet most r.f. and audio requirements; however, when smaller values are necessary, recourse to ceramics will provide capacity values down to 0.5 μμf. Paper capacitors, not hermetically sealed, are made in values up to 0.25 μf or so, with hermetically sealed papers, high quality oils and electrolytics going very much higher. It must be emphasized that these are only approximate ranges, inasmuch as new developments in capacitors are constantly expanding the scope of each type.

Mica capacitors are therefore recommended whenever the circuit at hand requires a stable, high *Q* (or low-loss), component of comparatively close tolerance. Resonant circuits, time constant charging circuits, and critical coupling applications are typical examples. For non-critical by-pass and coupling usage, it is economically more advantageous to utilize the high-*K* ceramics or paper capacitors.

CERAMIC CAPACITORS

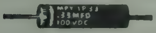
Ceramic capacitors may be broken into two general types. There are those having comparatively low dielectric constants with correspondingly low capacities, and there are those having extremely high *K*s.

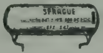
The lower-*K* capacitors are ideal for all rigorous circuitry requirements, in particular those requiring temperature compensation. Ten different temperature coefficients of capacitance are usually manufactured in the small values from 0.75 μμf to 300 μμf or so, the number decreasing as the capacity increases. As with mica capacitors, it is difficult to obtain large capacities with zero temperature coefficient in small physical sizes, the maximum Joint-Army-Navy (JAN) zero coefficient component being 360 μμf in a 2"-long tubular case. The coefficients generally standardized upon range from + 100 through 0 to – 750 p/m/° C, with cost decreasing in the same order. Tolerances for most range from 1 to 20% for values from 27 to 1,600 μμf. Smaller values have slightly looser tolerances due to the difficulties in measuring such minute capacities. Ceramics are available in all values cased in insulated bodies or in the form of uninsulated tubes.

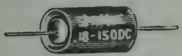
High-*K* capacitors provide the greatest capacities in the smallest space of all presently available receiving type capacitors. Although they suffer from poor temperature characteristics and are available only in comparatively poor tolerances, they are unexcelled for all general coupling and by-pass needs due to their lower cost and their small size. Capacitors of this type are available in the form of dime-size wafer-thin discs in values up to 10,000 μμf. These capacitors are rated at 500 volts or so for DC. All low-*K* capacitors are rated at 500 volts DC. Both types must be "de-rated" in the same manner as micas when AC operation is contemplated at the higher frequencies. It should be mentioned that the high-*K* varieties are unsuitable for use in resonant circuits, since their stability is unpredictable and since tolerances are so wide by comparison to low-*K* versions that precise frequency control will be impossible.

PAPER CAPACITORS

Paper capacitors are almost universally used when circuit requirements call for 10,000 μμf or more, since large micas are not available. In low cost equipments, they are often used in smaller values, although it appears that high-*K* ceramics will displace them in such usage. These components are made by rolling alternate strips of aluminum foil and specially treated chemically pure paper into tube-like shapes. The foil, when correctly brought out to two terminals, forms the plates which are separated by the dielectric paper. The assembly is packaged into paper or plastic tubes and rectangular cases, both types being very common. Better versions use two or three strips of one to two mil (1 mil = 1/1,000 inch) paper bonded together as the dielectric, while inexpensive varieties depend upon but one layer of one mil material. As is usual in engineering work, a compromise must be made with size and relative security against voltage breakdown versus a smaller, less expensive component.







With one layer of paper dielectric, 200 volts DC is the order of working voltage, while two- and three-layer capacitors can be relied upon at higher working voltages. Irrespective of the number of layers, it is absolutely necessary to keep moisture from collecting in the pores of the paper dielectric. Water will destroy these capacitors in a very short time, hence the unusual precautions to keep the innards of these components absolutely dry. Unfortunately, it is almost impossible to keep moisture from creeping in along the space, minute as it may seem, between the flexible leads and the body of the case. In military and good commercial equipment, all paper capacitors are hermetically sealed in metal cases to guard against this danger. The familiar "bathtubs" are paper capacitors having almost indefinite life when properly used within their voltage and temperature ratings.

Tolerances on paper capacitors are generally poorer than micas and ceramics of the low-*K* type, since the thickness of the paper dielectric cannot be maintained constant with any degree of precision. The paper itself is a poor dielectric at any but audio frequencies, thus limiting these capacitors to by-pass and coupling circuits. As mentioned previously, maximum operating temperatures must not be exceeded, otherwise premature failures will certainly occur. But despite these disadvantages, paper capacitors are almost universally used and will be until a superior type is devised. When correctly chosen for the application at hand, they will be relatively trouble-free. A 100% safety factor in working voltage rating is excellent assurance of long life dependability!

Soldering, Do it Right

Have you ever constructed a piece of electrical equipment only to find that it didn't work? After much work of checking to make sure each component in the circuit is workable, you finally decide that the reason it does not work is because of a "cold" solder joint. These "cold" solder joints, joints which fail to conduct electricity, are difficult to find and this problem could have been avoided by knowing how to correctly use a soldering iron and by using correct soldering techniques.

Before doing any soldering, the tip of the soldering iron or gun should be clean and properly tinned. If on inspection, the tip is discolored or scaley appearing, it is in need of cleaning and re-tinning. Cleaning should be done before the tip is heated. The tip can be cleaned with sand paper, a wire brush, or steel wool. After cleaning, the tip can be tinned by heating the tip and applying solder to the tip as soon as it is hot enough to melt the solder. Care should be taken not to allow the tip to discolor because of over-heating before the solder is applied. After preparing the soldering iron as described, it is ready for soldering.

A good solder joint is one that is bright after cooling as contrasted to a bad joint that is dull gray or frosty in appearance. A bad joint such as this can be caused by not applying enough heat or by moving the joint during cooling. To correct this, should it occur, the joint must be reheated. Reheating of a joint is also necessary when rosin appears to coat one part of the joint. This is an indication that both parts have not been evenly heated. To be assured of getting a good joint, here are a few "do's" and "don'ts" to follow when soldering.

1. Clean all metals to be soldered so that they are free from dirt, oxides, and grease. This can be done with sandpaper or by scraping the surfaces with a knife blade. Cleaning such as this insures a strong joint.
2. Support the joint mechanically where possible.
3. Large surfaces should be pre-tined before they are soldered together.
4. Solder should be applied to the joint and not to the tip. The joint should be heated sufficiently enough to cause the solder to flow evenly and freely. Both parts of the joint should be heated evenly.
5. Do not use too much solder. Too much solder not only shows a sign of poor workmanship, but it also can offer too much resistance to current flow and can cause the electrical apparatus to operate poorly or incorrectly.
6. Joints should be soldered as rapidly as possible so as not to overheat the components or burn the insulation.
7. In soldering electrical connections, only rosin-core solder or rosin flux should be used. Acid core solder or acid flux should never be used on copper or brass connections.

By keeping in mind these simple rules and tips, much better joints can be easily obtained. They will not only give a better looking and neater joint but will also help to achieve the best performance from the device.

Meet The Resistor

A very important phase of communications engineering is the selection of the best resistors and capacitors for the task at hand.

Resistors, as their name implies, are always used in electrical circuitry to resist current flow, and, therefore, in performing this function a certain amount of power is consumed, with a proportionate quantity of heat being liberated. The power generated in a circuit in which a resistor is used may be expressed in watts by the use of any one of the three following familiar expressions derived from Ohm's Law:

a) $P = EI$
b) $P = E^2/R$
c) $P = I^2R$

where:

E = Impressed EMF across the resistor, in volts
I = Current through the resistor, in amperes
R = Resistance, in ohms

In nature, all substances will resist current flow to some degree and, therefore, could be termed resistors. However, since their absolute resistance values often change with increasing time, as a steady current is impressed, most are unsuited for the precise requirements of electronics. In addition, the realization of large magnitudes of resistance cannot be practically achieved in small "packages" for the majority of substances. Hence the ideal resistor for radio work is small in size and free from random resistance changes with time, provided, of course, that the various ratings are not exceeded.

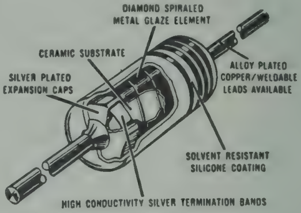
It becomes the responsibility of the designer to select resistors, using the above equations, which are not operated at more than the recommended wattage ratings specified by the manufacturers. To exceed the rated wattage is an open invitation to trouble, since excessive heat causes the resistive material to burn up or to suffer a large permanent change in specified resistance.

Most equipment designers incorporate a safety factor into their wattage requirements, the margin of safety being governed in large quantity production lots by the conflicting requirements of low cost and reliability. Fortunately, good commercial equipment design usually leaves plenty to spare, and there is little reason why it should do otherwise.

To aid in the selection of resistors, the discussion will be broken into two broad classes, namely composition (including carbon) and wire-wound varieties. Composition resistors are now available having power ratings up to 5 watts while greater wattages dictate the use of wire-wound resistors.

COMPOSITION RESISTORS

Fixed—Fixed composition resistors are among the most familiar items in all electronic equipment. In the past we have seen ingenious engineering and manufacturing techniques evolve new types vastly superior to the bulky troublesome carbon resistors of thirty-five years ago. The changes have been so great that comparisons between old and new are difficult to make. Size has materially decreased, while wattage capabilities and reliability have been tremendously improved. Among the varieties are molded resistors made from composition materials completely surrounded by attractive insulation. These resistors are produced in all standard Radio Manufacturing Association (RMA) values from several ohms to 22 megohms. Three different wattages are readily available, namely ½, 1, and 2, and each is considerably smaller than "older" resistors similarly rated. Many manufacturers of resistors elaborate rather completely on the published ratings by stating that, at the maximum wattage rating, a resistor operating at an *ambient* temperature of 70° Centigrade for 1,000 hours will not change resistance by more than 5%. The ambient temperature is the free air temperature surrounding the resistor. If it is placed where air circulation is restricted and the ambient exceeds 70° C, the resistor should be underrated for safety, the exact factor being governed by the aforementioned considerations of economy and reliability. For general work, it is well to use resistors rated at about twice the computed wattage, since the added cost is negligible.


DIAMOND SPIRALED METAL GLAZE ELEMENT
CERAMIC SUBSTRATE
SILVER PLATED EXPANSION CAPS
ALLOY PLATED COPPER/WELDABLE LEADS AVAILABLE
SOLVENT RESISTANT SILICONE COATING
HIGH CONDUCTIVITY SILVER TERMINATION BANDS

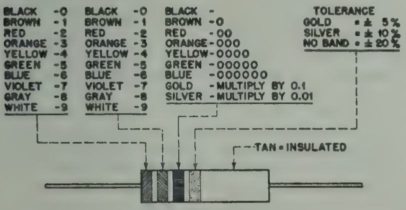
Some composition resistors are larger than others, depending upon the manufacturer. Extra size, which may complicate wiring and chassis layout especially in circuits using miniature tubes, is not advantageous, provided that the smaller unit is rated equally in wattage compared to the larger resistor under *similar* test conditions.

Several additional and important considerations enter the resistor picture other than wattage and size. These may appear unimportant to the occasional user of resistors, but extensive circuit work quickly brings to light the shortcomings of certain varieties. Leads, for example, should be sturdy enough to resist the abuse generally received; a 5 pound pull must be sustained without damage by resistors designed to meet Joint Army-Navy (JAN) Specifications. Further, leads should be hot-solder coated in manufacture so they readily take solder in wiring operations.

The actual resistance value itself is a most important factor, to say the least, since any circuit must necessarily use the nearest standard value to that computed in the design process, except in the case of extremely precise circuit applications.

However, most circuits are non-critical to the extent that a departure from a computed value of say, 21,500 ohms to the nearest standard value of 22,000 ohms (abbreviated 22K under the present system of conventional symbols and 22M under a generally discarded obsolete and 22M will do little to change performance. Since it is not unusual to find the bargain counter variety of resistors marked 22K (or any value for that matter) to be off from the specified value by as much as 30% or ±6.6K in this case, considerable trouble might conceivably arise, especially with voltage dividers. Thus, resistance *tolerance* also enters the picture along with all the other ratings. Most good resistors are available on the market with a ± 10% tolerance guaranteed, 5% being supplied at extra cost. Plate, cathode bias, and grid resistors, other than bias voltage dividers, normally are ordered in the 10% or 20% tolerance by most equipment designers; the 5% varieties finding greater use in critical circuits. When precision resistors are required, the circuit is generally so labeled.

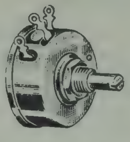
Resistors are also rated by their manufacturers for maximum safe impressed voltage. Overrating resistors in voltage, even while operating *below* maximum power ratings, may quickly result in a burnout due to internal arcing with accompanying changes in resistance values. 350 volts is just about the maximum voltage to which a ½-watt resistor should be subjected, while 500 and 1,000 volts are the limits for 1 and 2 watters respectively. These figures are for certain specific resistors. Other varieties vary from these figures to some degree.

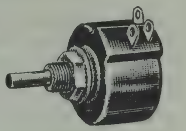


Since resistors, especially ½-watt varieties, are exceedingly small in size, it becomes difficult to mark the resistance value clearly on the surface in such a manner that permanence is assured. The Radio Manufacturers Association (RMA) has specified a system of color coding of resistors (and capacitors, incidentally) by means of three or four colored bands painted around the units. Reading from the painted band close to the end *inwards*, it is an easy matter to identify the resistance value. The 22K resistor mentioned earlier will be coded red-red-orange, corresponding to 2 (red) 2 (red) with 3 (orange) zeros as a multiplier. A fourth band designates the tolerance of the particular unit, while the use of tan as a body color indicates that an insulated case is used. A 15-ohm resistor will be coded brown-green-black, the black indicating an absence of any zeros following the 1 (brown) 5 (green). The leading brands of resistors use the RMA color code and also mark the resistance values and the wattage on the body as an added convenience to the user. Color blind persons find this feature of great assistance.

Having discussed fixed composition resistors, we will turn to variable composition resistors, better known as "pots" or potentiometers, to look into some of their salient features.

Variable—Early variable resistors were often wire wound, not because of power considerations but rather because the know-how concerning the manufacture of good small carbon and composition "pots" was lacking. Fortunately, this deficiency has been corrected with the advent of new fabricating techniques, and pots are now less troublesome than ever before.





Basically a pot consists of some resistive substance mounted in a circular fashion, having a sliding tap moving over the resistance itself. Newer versions use a single composition material to serve as both base and resistance element itself, while others use a separate insulating base with an applied coating of resistive material (usually carbon in an adhesive binder) deposited on top. The composition pot is usually capable of greater heat dissipation than that realized with the two-element type (of similar dimensions, of course) since heat developed is rapidly carried away in the one-piece pot.

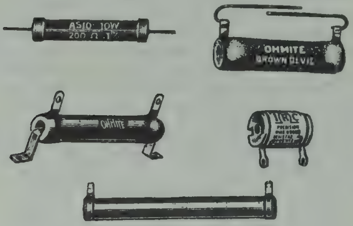
A rather thick resistance element should be used when one considers that a pot may experience many thousand cycles during its life (a cycle being a complete rotation of the shaft in one direction and back again) and that the slider will thus wear down the element somewhat. Relaxing the slider pressure on the element is one cure for wear which can be realized at the expense of the good contact so necessary for noise-free electrical performance. Since most pot manufacturers support the shaft and the attached slider by but one bearing, a good contact is not always present. A step forward is a recently announced pot having the shaft supported at two points, thus helping to keep the slider pressure constant.

A few points of additional interest concerning pots are worthy of mention. Not all pots change resistance in direct proportion to angular shaft rotation. Some experience great resistance changes during the first few degrees of rotation and taper off gradually thereafter and vice versa. This feature is purposely included to accommodate circuits requiring a non-linear voltage change to secure a desired over-all response. The "taper" of any pot is graphically illustrated in data sheets published by the manufacturers, and many versions are available. For general work, it seems advisable to recommend the use of the easily obtained "linear" taper offering resistance change directly proportional to angular shaft movement. For audio work however a control with an "audio taper" must be used to allow smooth volume control.

The usual resistor ratings specifying maximum power and voltage hold for pots as well, and, in addition, one may order a pot in several tolerance values, the most readily available usually being 20%. Color coding is not used for pots, since the actual resistance value is usually marked on the case. Unfortunately, some pots are unmarked in resistance values as some manufacturers use a private code number.

WIRE WOUND RESISTORS

Fixed—When it is necessary to use a single resistor in a circuit where the power will exceed two or more watts, general practice dictates the use of a wire wound resistor. The main reason for this stems from the inability of carbon and composition resistors to radiate satisfactorily large quantities of excess heat. A resistor made using a winding of sufficiently large gauge high resistance wire can be fashioned to spread the coil over a large volume, thus improving cooling considerably.



Fixed

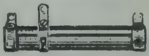
Since wire wound resistors are generally sealed into protective ceramic or other insulation after winding, few are acquainted with their actual "innards." Several points are of interest, the final being that most wire-wound resistors are *inductive* since the winding is in reality a small coil. At higher frequencies the inductance of ordinary wire-wound resistors can become objectionable when they are used in RF circuits. For such applications it is advisable to use one of the several varieties of *non-inductive* wire-wound resistors. "Non-inductive" means that a good part of the inductance has been canceled out by the use of a criss-cross winding process. It should be mentioned that carbon and composition resistors have a negligible amount of inductance, even less than the special non-inductive wire-wound versions.

Small wirewound resistors in the 5 and 10-watt classes, especially those having resistances exceeding 10K, often are extremely close-wound with wire having a diameter of 1 or 2 mils (1 mil = .001 inch). Great pains are taken by the various manufacturers to prevent shorting between these very closely spaced turns. Further pains are taken to prevent moisture from attacking the wire itself, thus opening the door to the not unfamiliar annoyance of an "open" resistor. Long performance life is most important for wire wound resistors, since they are often used in protective high voltage bleeder applications where an open circuit can mean instant death.

When selecting wire-wound resistors, especially those having large resistances, it pays to play safe by selecting wattages at least twice those computed. Such precaution insures that larger wire than necessary will be present.

Note that some brands may conveniently be mounted with their insulated bodies resting directly upon grounded metal and that others require mounting above the chassis using brackets which are generally supplied. A variety of terminal arrangements and body shapes are available on the market so that the experimentor may obtain almost any desired mounting. Remember that regardless of brand, all wire-wound resistors need cooling air. Locate them not in tight corners of a chassis but out in a clear space where adequate air circulation is present.

Variable—Wire-wound resistors may be purchased in two variable forms. The first type is a modified fixed wire-wound resistor having an added sliding contact touching a section of exposed resistance element, thus allowing the selection of any part of the total over-all resistance. Slider versions are rather useful in circuitry requiring infrequent adjustments since the slider itself, when frequently moved over the small diameter wire, tends to wear out the resistance element. This, coupled with the aforementioned disadvantage of having the resistance wire exposed in part to air and moisture, tends to identify slider-type wire-wound resistors as slightly less reliable from a life standpoint. Sometimes the resistor is so wired into a circuit to place the slider itself at some voltage potential with respect to ground, thereby introducing a shock hazard to anyone attempting an adjustment with power on. Taking these factors into consideration, the designer must also use the same precautions concerning wire size and cooling as apply to fixed wire-wound resistors. When adjusting the slider on a variable resistor great care should be exercised to avoid damaging the winding. The slider should be fully loosened before each move.



Adjustable

The wire-wound rheostats and potentiometers constituting the second form of variable wire resistors are used when large wattages, usually more than 2 watts, are being dissipated. Designed for use in circuits frequently needing adjustments, they are ideally suited for all but certain applications where the jump in resistance as the slider passes from turn to turn proves to be a source of electrical noise. Note that the change in over-all resistance of a wire-wound pot is not a steady unbroken variation (as found in carbon and composition pot) but is rather a series of jumps, the number depending on the number of turns used.

Thus we have discussed the most frequently used types of resistors from their most salient features; other facts necessarily enter into the picture, but space limitations prevent a more elaborate discussion.

TRANSMITTERS

1 Tube CW Transmitter

The rig is built on a 5″ × 2″ × 3″ aluminum minibox. Layout of the parts is not critical and can be left up to the individual builder. The diagram is so simple you can probably have it built in a few hours.

The 117N7GT does not need a line cord resistor and it operates directly from the 117 volts a.c. or d.c. It will also operate from 135 volts d.c. for emergency operation by using two 67½ volt batteries in series and applying the voltage directly to the line cord. What could be more simple?

The transmitter uses cathode keying with a 0.1 mf bypass capacitor condenser.

Tuning is done by a 100 mmf variable which must be insulated from the chassis. This can be done by using a rubber grommet or any other ingenius method you can devise. Further tuning is done by another 100 mmf capacitor connected in series with the antenna. This capacitor should also be insulated from the chassis.

The parts list of the transmitter are not critical by any means. I used a dual electrolitic condenser with 25-25 mf at 150 volts instead of two 16 mf units. Also used are two half watt resistors to obtain 50k. I had no crystal socket around so I used an FM/TV antenna connection of the type you see in the walls at hospitals, motels, etc.

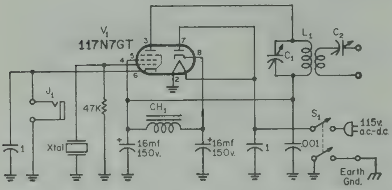


Fig. 1—Circuit of the one tube transmitter. The transformerless power supply makes a good ground and a single wire line cord mandatory for safety as explained in the text.

C_1, C_2—100 mmf variables, receiver type.
Ch_1—12 h, 250 ohms d.c. resistance.
L_1—80 m. B&W JEL-40, 26 t. #18 1⅞″ dia., 2½″ long with 5 turn link. For 40 m. operation short out half the turns. Coil may be wound on 1⅜″ dia. form with 18t #18 e. 2″ long.

Operation

After the construction is complete, check your wiring carefully. Any error might burn out the tube which is not inexpensive.

Connect the chassis to a good ground and insert the power plug. If the tube does not light, reverse the plug. The tube will light with the plug in one of the positions. Do not bypass this arrangement with a conventional line cord as this will create a short circuit hazard with the ground connected or a lethal shock hazard without the ground.

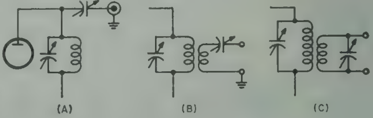


Fig. 2—Shown are several methods of feeding an antenna. The coil data are listed in fig. 1.

Insert a 40 or 80 meter crystal and the proper coil. Tune your receiver to the crystal frequency. Close the key and adjust C_1 until the signal is heard in the receiver. Adjust C_1 for the strongest signal and maximum stability. That is, each time you open the key and close it, be sure the crystal kicks over without delay.

A meter, 0 to 30 ma, can be connected across the key terminals and then C_1 can be tuned for a dip (and then move slightly off resonance for good stability). A field strength meter may also be used for tuneup. Capacitor C_2 should be adjusted for maximum field strength meter indication and then C_1 should be retuned.

1 Tube For 8 Watts

A good mica padder is used for plate tuning, being a few cents less than a purchased broadcast tuning capacitor (which of course could be used.)

Stealing tubes is easy. Without *any* change in wiring, the 6F6, 6K6, 6V6, 6L6, 12A6, 12V6, 25L6, 35L6, and 50L6 work fine. With this variety of tubes to choose from, it should be easy to find an un-needed piece of equipment from which to borrow one. While you are at it, you had just as well take the equipment—after all, the socket from which you removed the tube did have the proper filament and B+ voltages available—take an old octal tube base and wire a power cord into the socket.This way, after you have removed the tube to plug into the transmitter, you can take the power from the robbed socket. (This trick is a shameless steal from *QST* and several editions of various ARRL books.) One hint: take the B+ from the screen supply as an inductive output transformer may mess up your keying. Also, the plate supply voltage may be too high for the transmitter screen.

One common question (there have been dozens of these transmitters built by beginners) is "What B+ voltage *do* you need?" Generally the range I recommend is 90 to 150 volts for the 25, 35, and 50 (filament) volt tubes, 90 to 250 volts for the others, with possibly a 300 volt maximum for the 6L6 (but that's pushing.) This brings up the other question: "Can G, GT, GA, GB, or GC versions of these tubes be used?" I've tried them all, and they all work.

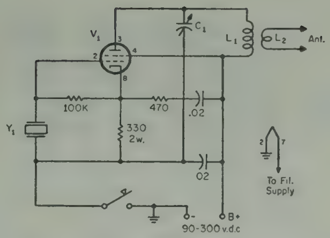
There is one danger in stealing the voltage from an a.c.-d.c. broadcast receiver or record player. Both sides of the key are hot. The elegant way to eliminate this danger is to connect the receiver to the line through a forty-watt isolation transformer. That costs money. I put the *whole* key inside of two plastic laundry bags, one over the other. Replace them at the least sign of wear, and inspect them often. Use a keying relay if you aren't a very careful person.

The layout is not critical. A chassis is not even necessary, though I like to mount the parts on a frame of some sort. I also like to use short leads, for this generally helps performance in any equipment and discourages TVI.

Special Tricks

Most hams know that the usual FT-243 crystal holder will fit in the ordinary octal socket; few realize that *two* of the crystal holders will fit in the same socket at the same time. Thus if you have a holder with a defective crystal, you can make from it a connector for your antenna and ground and use one half of an octal socket for the crystal, the other half for the antenna and ground connector. Should the ham not have an unused crystal holder, an old-fashioned Moseley TV lead-in connector (male) will do the job even better.

A major transmitter expense is in the current indicator used for transmitter tuning. A #49 pilot lamp lights to full brillance on 60 ma. If a little cylinder of black paper is slipped over the lamp (end open) a dull glow can still be seen at 20 ma. When tuning, resonance is indicated by lamp dimming. Loading is shown by increased brightness. The lamp is good for all tubes but the 6L6 and good there if a 33 ohm ½ watt resistor parallels it. If connections are soldered to the lamp base with stiff wire there is no need for a lamp socket.



Circuit of a simple one tube rig. The tube may be a 6F6, 6K6, 6V6 6Y6, 6L6, 25L6, 35L6, 50L6, 12A6, etc. The basing is the same for all these tubes but the filament voltage requirements may differ. All capacitors are in mf and all resistors are ½ watt unless otherwise noted.

C_1— 60-300 mmf compression trimmer, El-Menco 303-M.
L_1— 40 M—11t # 18, 1¼"d., 1¼" long.
80 M—18t # 18, 1½"d., 1½" long.
160 M—33t # 24, 1½"d., 1½" long.
L_2— 40 M— 3t # 18, 1¼"d., closewound.
80 M— 4t # 18, 1½"d., closewound.
160 M— 8t # 18, 1½"d., closewound.
Y_1—See text

Other Bands

While the transmitter was basically designed for 40 meters, it also works well with different coils on 160 and 80 meters. Keying and power output are just as good, though of course the distances of the average contact are less. The prime requirement for the coils for the other bands is that they have enough turns to be resonant with the tuning capacitor near maximum capacitance. The link should have ¼ to 1/3 as many turns as the plate coil, the actual number of turns and link position depending on what is necessary to load the users antenna.

For some reason the oscillator does a pretty good job tripling the crystal frequency. Thus, if the transmitter is made with plug-in coils, make sure the 40 meter coil is *not* plugged in when using an 80 meter crystal.

16 Watt "Rock Crusher" for 40 & 80

This "fun rig" is not a toy, keys beautifully without chirping, delivers a true T9X signal, tunes easily, and is a natural for break-in c.w. operation. The r.f. output measures a full 16 watts, and the originally installed 50L6 final shows no distress and delivers full output after nine months of hard use.

My log book shows consistent and solid W6, W7-land ragchew contacts, and in addition is almost WAS. on 40 meters in a two-month period, W-1's and VE's included.

"Rock-Crusher MK II" is tranformerless, employs a safe, grounded chassis and does not require a polarized power plug. Voltage doubling with silicon diode rectifiers delivers 340 volts for plate supply and the regulation is excellent. Perfect chirpless keying is further guaranteed by the OA2 applied to the crystal oscillator screen.

A #47 dial lamp may be used for a plate "meter," but an inexpensive 0-100 ma meter is

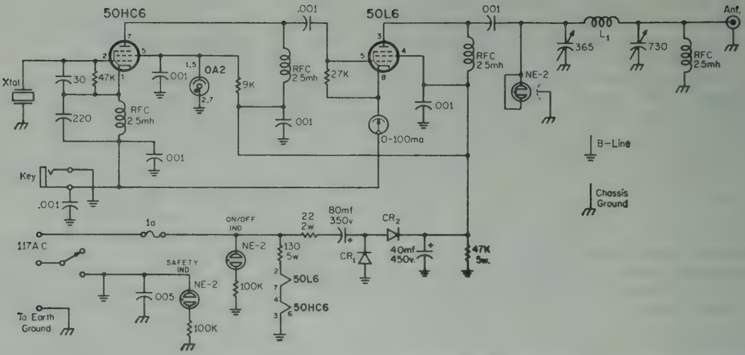


Fig. 1—Circuit of a 16 watt crystal controlled transmitters for 40 or 80 meters. All resistors are ½ watt unless marked otherwise. All capacitors greater in value than one in mmf and less than one in mf unless otherwise indicated. The diodes CR_1 and CR_2 are silicon units rated at 200 ma with a peak inverse voltage of 400 volts. Inductor L_1 is a BW #3018 unit. The two ground symbols shown in the diagram are not to be confused. As marked, one represents the B minus line and the other chassis ground.

recommended for tuning purposes. Observation of this meter and the NE-2 neon lamp are adequate for tune-up. Fairly inactive crystals perform well in this circuit. A 15-watt lamp connected to the output terminals will aid in becoming acquainted with tune-up procedures.

The circuit is quite straightforward and the arrangement of the parts is not critical. Note that the 80 mf capacitor in the voltage doubler is *not* grounded. This item should be paper covered and polarity observed when connecting.

The NE-2 lamp leads, for the output indicator, should be twisted together and soldered to the hot end of the tank coil, that is the end connected to the plate blocking capacitor. It will be lighted by self-capacity to ground and may be installed protruding through the front of the control panel for convenience of observation.

A 3-30 mmf padder capacitor is suggested for the 50HC6 crystal oscillator grid circuit, in place of the fixed 30 mmf capacitor, to obtain optimum drive from crystals of low activity.

"Rock-Crusher MK II" is constructed on a 7½" × 4¼" chassis salvaged from an old Q multiplier chassis. A unit built by WA6VLI is illustrated as a typical finished product.

None of the parts are special—most may be found in the average ham junk box. If all new parts are used, the cost will approximate $20. The coil-capacitor combination covers both 40 and 80 meters without switching, a real operating convenience, so the band is selected by changing crystals and retuning.

The circuit, shown in fig. 1, is liberally sprinkled with two ground symbols. One indicates the B minus line and the other indicates chassis ground. It is extremely important to observe these two symbols. For reasons of safety the B minus wires are not to be connected to the chassis. All B minus connections should be tied to a buss line insulated from the chassis. The key jack, connected to the B minus line, must be insulated from the chassis with shoulder washers.

To reduce TVI, the cabinet should be tied to earth ground through a water pipe or a direct ground pipe if possible. If care is not exercised a shock hazard exists between the key and the grounded cabinet. The hazard is eliminated when the line plug is properly inserted in the outlet. The second neon bulb, marked Safety Indicator, lights up when a shock hazard exists due to wrong plug polarity. When this is observed, reverse the lineplug, the light will go out and the rig is safe.

Operation

Set up the transmitter by first connecting the earth ground to the cabinet. Plug the line cord in, turn the power switch on and check the safety indicator. If it lights, reverse the plug. Plug in the proper crystal for the 40 or 80 meter band. With the coil and capacitor combination used, the tank tunes both bands. Forty meter crystals will tune with the 365 mmf plate capacitor mostly unmeshed and 80 meters rocks will tune with the plates mostly meshed.

Set the ANTENNA tuning capacitor fully meshed and the PLATE capacitor (365 mmf) meshed or unmeshed, depending upon the band. With a 15 watt bulb connected to the antenna terminal, press the key. Tune the PLATE capacitor for minimum reading on the meter. Decrease the capacity of the ANTENNA capacitor until the plate current rises to 50 ma. Retune the plate capacitor to minimum. Repeat once or twice and you should be set. Connect the antenna, retune quickly and you are on the air.

22 Watts on 40 & 80

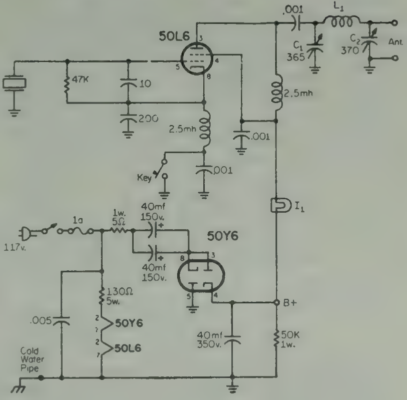
The circuit lends itself to quick, compact, and inexpensive construction. Construction should be even less expensive with the aid of an a.c.-d.c. radio with its supply of sockets, resistors, capacitors, and possibly tubes. Octal sockets are especially helpful to mount crystals (every other pin in an octal tube base will fit the standard FT 243 crystal holder). The same socket will accept the key plug. An FT243 holder with its crystal removed serves as a plug nicely. Electrolytics may be mounted in octal plugs thus saving sub-chassis space.

A note of caution. To use the octal base of an undesired tube for mounting electrolytics, break the glass with a hammer, but first wrap the tube with a rag or paper bag for implosion protection.

Inductor L_1, in my unit, when used with C_6 and C_7, will resonate for both 40 and 80 meter crystals. Yes, the 80 meter crystal will harmonically tune to 40 meters.

This little rig really works like a charm. As shown in the schematic, a pilot light is used as the plate current resonance indicator.

Now connect a 25 watt light bulb between the antenna terminal and the chassis to serve as a dummy antenna. With the line voltage normal, and tubes fully lit, look for a current "dip" in the plate current resonance bulb. Watch your receiver because this rig puts out a good signal. The rig should light the 25 watt bulb to nearly full brilliance. Now remove the dummy antenna and connect your antenna between the output terminal and the chassis.



Circuit of a 22 watt c.w. transmitter using a transformerless power supply. Capacitors C_1 and C_2 are broadcast type variables with 365 mmf per section. For C_1 only one section is used but for C_2 both sections are paralleled. Inductor L_1 contains 34 turns of B&W #3011 coil stock. Capacitors not marked should be rated for at least 400 volts breakdown. All capacitors greater than one are in mmf and less than one in mf unless otherwise noted. I_1 is used as a plate current indicator and is a #47 lamp.

I built two models of this transmitter. The first was experimental. It was bread-boarded, had long leads, and practically no shielding, and as I expected it "wiped out" almost all the lower TV channels. Short leads, good shielding, and adequate r.f. bypassing helped to eliminate TVI, as proven in the final unit.

15 Watts Mobile on 75

The entire transmitter is enclosed in a 3½" × 6" × 8" aluminum box (BUD CU-3009A). The rig is roughly divided into two layers by means of a 3/32" aluminum mounting plate onto which several subassemblies are attached. The lower layer consists of the v.f.o. and final amplifier subassemblies while the upper layer holds the two relays, driver transformer T_2, and the voltage regulator subassembly. The mounting plate with subassemblies attached is set into the case during the latter stages of assembly. Reaching into both layers are modulation transformer T_3 and the modulator subassembly.

The v.f.o. assembly is a self contained unit built into a compact aluminum box (LMB 650). A "U" shaped partition provides a shielded compartment for the frequency determining components (see dotted portions of fig. 1). Maximum mechanical stability must be the goal while assembling parts in this compartment. All wires and leads should be short and direct. Inductor L_1 is tightly wound on a ceramic slug tuned form. The collars of this form are movable to adjust to coil length; after the coil is wound and the ends soldered, the collars are cemented in place. Two holes in the partition allow wires to pass from the shielded compartment to the socket of V_1. A two lug terminal strip is mounted with the lugs adjacent to the holes in the partition. Capacitors C_1 and C_5 are soldered in place between the terminal strip and a ground lug.

The remaining section contains V_1, V_2 and the balance of the electrical components shown inside the dotted portion of fig. 1. Filament bypass capacitor C_{20} is soldered directly to pin 4 of V_1. Filament and plate power leads, and

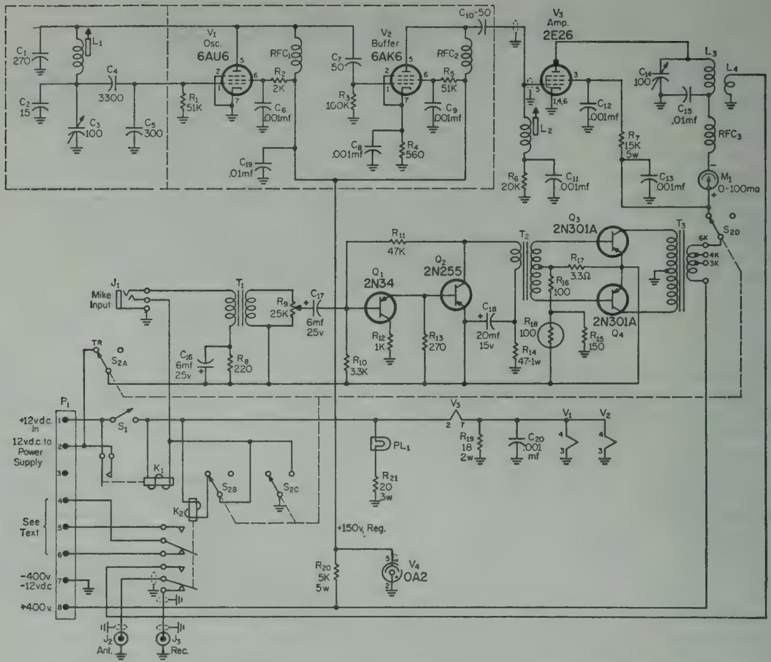


Fig. 1—Circuit of the 75 meter "Monobander." The 6AU6 v.f.o. operating in the 75 meter band, drives the 6AK6 buffer. The output feeds a 2E26 which is plate modulated by Q_3 and Q_4 operating in class B. All resistors are ½ watt and all capacitors are in mmf unless otherwise noted. All micas are silver mica and the .001 and .01 values are disc ceramics.

J_2 J_3—Double phone jack, Cinch Jones 81B or equiv.

K_1—S.p.d.t. relay, 12 v.d.c. Potter Brumfield KA5D or equiv.

K_2—D.p.d.t. relay, 12 v.d.c. Advance AM/2C/12VD or equiv.

L_1—35t, #36E, closewound on ⅜" form, Millen 69052.

L_2—60t, #38E, closewound on ¼" form, J. W. Miller 4500.

L_3—40t, #24E, closewound on ¾" form.

L_4—1 to 3t, #22 plastic ins., closewound on cold end of L_3.

P_1—Male chassis plug, 8 contacts. Cinch Jones P-308-AB or equiv.

PL_1—Panel Light. Dialco 4-1930 with #328 bulb or equiv.

R_{18}—Thermistor, 100 ohms at 25°C. Veco-21WI.

RFC_1, RFC_2—2.5 mh. National R-50 or equiv.

RFC_3—2.5 mh midget type. Millen or equiv.

S_2—4 p.d.t. switch. Mallory 3242J or equiv.

T_1—Mike input, 200 ohm pri., 15K secondary. Argonne AR-107 or equiv.

T_2—Driver, 100 ohm pri., 100 ohm c.t. secondary. Tried TY61X or equiv.

T_3—Mod. trans., 32 ohm c.t. pri., secondary tapped 3000, 4000 and 6000 ohms. Triad TY-65Z.

the shielded v.f.o. output lead are brought out of the unit near the base of V_2. Layout of parts in either compartment is not critical; more emphasis is placed on short direct leads and mechanical rigidity. Both V_1 and V_2 are firmly secured in place by heat dissipating tube shields (I.E.R.C. Cat. No. TR50Z0H).

With the cover securely in place, the v.f.o. unit is ready for test and adjustments. Apply 6.3 volts to the filaments and 150 volts to the plates. Tune a receiver, with b.f.o. on, to just over 4.0 mc. Set C_3 to minimum capacity and tune the slug of L_1, the v.f.o. set, until the v.f.o. signal is zero-beat on the receiver. Lock the slug in this position. Now increase the capacity of C_3 while following the v.f.o. signal with the receiver. With C_3 fully meshed the v.f.o. frequency should fall below 3.8 mc. My v.f.o. bandspreads the 3.8 to 4.0 mc range over 80 percent of the dial. If the v.f.o. does not reach 3.8 mc with C_3 closed and L_1 set to maximum inductance, add more turns to L_1.

The final amplifier stage is assembled on a "U"-shaped chassis which supports final tuning capacitor C_{14} at one end and V_3 at the other. Inductor L_3 is located between C_{14} and V_3 and is supported in a horizontal position. Midget choke, RFC_3, is soldered to standoff terminals along side C_{14}. A lug under one of the standoffs serves to ground tank bypass capacitor C_{15}, and one end of link coil L_4; the other end of L_4 is supported by a standoff terminal. The number of turns on L_4 should be determined experimentally for best loading with the antenna system to be used; one or two turns will usually be sufficient. The loading should remain substantially constant over the entire phone band thereby eliminating a loading control from the panel.

Neutralizing the final amplifier was found to be unnecessary because of the excellent shielding between the grid and plate circuits afforded by the physical construction and layout. Ventilation for the 2E26 is accomplished by a series of holes along the bottom and side of the case near the tube. This arrangement of holes allows heat to be removed by convection currents flowing up into the bottom holes and out the holes at the side. The holes are given a finished appearance by the use of aluminum eyelets obtainable from most "five-and-dime" stores.

After the v.f.o. and amplifier assemblies are fastened under the mounting plate, grid coil L_2 is set in place. Grid leak R_6-C_{11} is located close to the chassis between L_2 and the socket of V_3. Screen dropping resistor R_7 and filament resistor R_{19} are also under the mounting plate and are held by component mounting clips (Atlas E.E., catalog number 100 200-5-12). The voltage regulator assembly, T_2, and both relays are on top of the mounting plate. The rear of the transmitter is arranged to mount antenna jacks J_2 and J_3, power connector P_1, modulator output transistors Q_3 and Q_4 and thermistor R_{18}.

Sheets of mica insulation and fibre shoulder washers are used to insulate the body of the output transistors from the case. A similar arrangement holds the thermistor in place. The thermistor is located near the output transistors so that it can sense the temperature at which they are operating.

The modulator assembly is built around a J-shaped bracket which sits in a cut out portion of the mounting plate. The assembly is held in place against the panel by microphone jack J_1 which passes through both the bracket and the panel. The shaft of modulation control R_9 is cut just even with the face of the bracket and is slotted. With the bracket in place against the panel the slotted shaft is immediately behind a ¼" hole in the panel labeled AUDIO. Occasional changes in modulation level can be made through the panel with a screwdriver. The bracket supports microphone input transformer T_1, modulation control R_9, driver transistor Q_2 and an insulating board which has mounted to it Q_1, R_8, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, C_{16}, C_{17} and C_{18}. Components are mounted to the board by their leads which are inserted through small holes drilled in the board. The leads are clipped to approximately ⅛" and connections are made to these ends. Solder connections to Q_1 must be made quickly; prolonged application of a soldering iron may damage the transistor. Two bushings support the board away from the bracket. The collector of Q_2 is connected into the circuit after the board is in place. Connections are made to Q_2 base and emitter pins by passing contacts through holes in the board and onto the pins. Suitable contacts can be removed from a seven or nine pin miniature tube socket.

The voltage regulator assembly is an L-shaped bracket which supports V_4 and R_{20} on one side, and the network of base bias resistors R_{15}, R_{16}, and R_{17}, which are on the other side and supported on miniature terminal strips. Another terminal strip holds each end of the secondary winding of T_2; from here connections are made to the bases of Q_3 and Q_4 by means of two more pin contacts. The three secondary taps of T_3 are connected to a 3 lug terminal strip located near the tip of V_4, but only the 6000 ohm tap is used.

Placing spotting switch S_2 in the ZERO position performs four switching operations necessary to put the transmitter into this mode of operation; section C operates K_1 which in turn supplies battery power to energize the high voltage supply. Section D disconnects the final amplifier. Section A disconnects the modulator and Section B disconnects K_2. This combination of connections allows high voltage to enter the transmitter where it is dropped to 150 volts by V_4 and puts the v.f.o. into operation. Relay K_2 is left in the receive position to allow signals to be received in order that the v.f.o. can be zero-beat against them. Disconnecting the final prevents over-loading the receiver; disconnecting the modulator prevents possible damage to the modulation transformer during this period when the secondary is unloaded. When S_2 is in the TRANS position the modulator and amplifier are connected into the circuit and both relays are ready to operate. The transmitter is put into operation by connecting the tip contact of J_1 to ground by means of the press-to-talk switch.

Relay K_2 has two sets of s.p.d.t. contacts. One set switches the antenna from the receiving circuits to link coil L_4. The other set of contacts silences the receiving equipment to prevent audio feedback during periods of transmission, either by opening a B plus lead in the receiver or by shorting the speaker voice coil; pins 4, 5, and 6 are available at P_1 for this purpose.

The r.f. portion (v.f.o. buffer, and final) of the transmitter should be bench tested before assembly into the case and before connecting in the modulator circuits. A 300 volt, 100 ma B plus supply, and a 12 volt d.c. source (auto battery) are required. Also, a noninductive 50 ohm resistor should be connected across link L_4 to load the amplifier. A milliammeter is temporarily inserted in the final grid circuit between the grid leak and ground, and L_2 is adjusted for approximately 3 ma of grid drive. Screen voltage should be 170 volts. With this power input the approximate power output is 13.5 watts. The input to the 2E26 amplifier can be boosted to 20 watts by using a 400 volt supply and changing resistor R_7 to provide 200 volts to the screen grid. Tuning capacitor C_{14} must also be changed to a unit having .025 inch plate spacing (Johnson type "J" series). Grid drive should be adjusted to approximately 3.5 ma.

Tests of this transmitter has shown excellent v.f.o. stability even over rough roads and varying battery voltage. Audio quality is good with most of the speech concentrated in the 100 to 3000 cycle range. To make the transmitter manipulations even easier a flat plug is used on the microphone cable; this allows the hand to move quickly from the VFO dial across to the TUNING dial.

1 KW Linear 10 to 80

The 6C21 is a radar pulse tube with an amplification factor of 30, which is slightly less than the 450TH. Filament requirements are 8.2 volts at 17 amps. However, for r.f. service 7.5 volts at 15 amps is adequate. For all practical purposes the specifications for the 450TH can be used. New 6C21's are available from most surplus houses for about $15.00[1]. They were made by several manufacturers including Machlett, Eimac, Westinghouse and General Electric. An engineer employed by Machlett indicated a conservative plate dissipation of 450 watts. Our estimate is about 600 watts. In any event they will loaf along at 1 kw input. In our opinion these husky triodes are one of the finest buys on the surplus market. (Amateur net on the 450TH is $75.00.)

After many years of storage these tubes tend to become gassy. The tube should be operated with filament voltage only, for about an hour, before plate voltage is applied. Our experience with 4 new 6C21's showed 3 of them to be gassy when taken out of the crate. This was evident by the tube turning blue and the plate supply overload relay kicking out when plate voltage was applied. However, all of them checked out as good as new after a short "cooking" period with only the filament voltage connected.

Conventional pi-network output is used in the plate circuit shown in fig. 1. The cathode circuit is tuned and there is a separate tank circuit for each of the ham bands. By tuning the cathode circuit, efficiency is increased and drive requirements are lowered. Equally important, it provides a convenient way to present a 52 ohm load to the exciter. The amplifier is neutralized by the field expedient method, this was found necessary for 10 and 15 meter operation. Having had a B&W FC30 filament choke on hand we incorporated this in the neutralization circuit rather than wind separate filament coils. The B&W FC30 is actually 4 chokes in one can. Two of these are tied together and feed one filament leg. One choke is used to feed the other filament leg. Neutralization voltage is fed through capacitor C_7 into the unused filament choke.

Construction

The unit is built on a 17 × 13 × 4 inch chassis, parts layout can be seen in the photos. All of the components for the cathode circuit except C_6 are mounted in a 12 × 7 × 3 inch chassis set vertically on the main chassis.

To keep panel height to a minimum, the socket for the 6C21 is mounted flush with the chassis. This also provides excellent shielding between input and output circuits. Loading capacitor C_9 is in a shielded compartment formed by mounting a 4 inch aluminum partition from front to rear on the underside of the chassis.

The entire amplifier is enclosed in Reynolds do it yourself aluminum. The framework for the enclosure is made of ¾ inch aluminum angle. All leads passing through the chassis are bypassed with coaxial capacitors.

A series of ¾ inch holes are punched around the tube socket. The chassis is pressurized by a blower mounted in the top of the relay rack. The blower intake is covered by a spun glass air conditioner filter to remove dust and dirt. A 6 inch hole is cut in the top cover directly over the tube and covered with decorative aluminum screen. The 2 inch air fitting and elbow on the rear of the chassis can be purchased in most hardware stores. They are known as a closet spud and flush elbow. A length of 2 inch automotive defroster hose is used to connect the blower to the chassis.

Due to the large physical size of the tube, very little forced air cooling is required. Fifteen

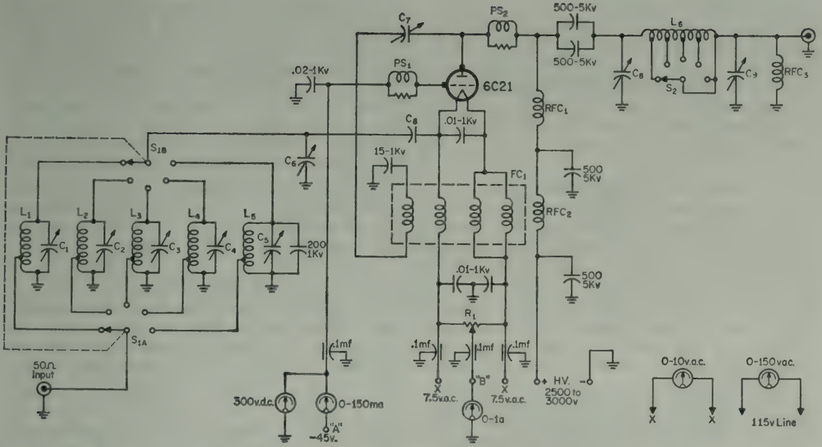


Fig. 1—Circuit of a g.g. kw amplifier. Coaxial capacitors marked 0.1 are Sprague Hypass 80P3. Capacitors marked 500 5 kv are CRL 8585-500.

C_1, C_2, C_3, C_4, C_5—100 mmf, Johnson 100R12.
C_6—300 mmf, Bud MC1860 or equiv.
C_7—1.7 to 10.7 mmf neutralizing capacitor. Johnson N375 or equiv.
C_8—31 to 151 mmf, 0.175 inch spacing. Johnson 150D70 or equiv.
C_9—50 to 1500 mmf. Cardwell PL-8013 or equiv.
FC_1—B & W FC-30.
L_1—28 mc, 4 t #12, ⅝″ diam., 1½″ long, tapped ¼ t from top.
L_2—21 mc, 5 t #12, ⅝″ diam., 1½″ long, tapped ¾ t from top.
L_3—14 mc, 9 t #12, ⅝″ diam., 2″ long, tapped 4 t from top.
L_4—7 mc, 20 t #16, ¾″ diam., 2″ long, tapped 10 t from top.
L_5—3.5 mc, 34 t #18, 1″ diam., 2″ long, tapped 13 t from top.
L_6—B&W 850A pi-network.
PS_1—8t #12, ½ d. 2″ long shunted with 9 100 ohm 2W carbon resistors in parallel. Tot. res. 10 ohms.
PS_2—3½ t #12, ⅜ d. 1¼″ long shunted with 9 470 ohm 2W carbon resistors in parallel. Tot. res. 50 ohms.
R_1—25 ohms, 50w, center tapped.
RFC_1—B&W 800 plate choke.
RFC_2—20 t #16, ⅜″ diam., 1″ long.
RFC_3—1 mh, 300 ma. National R 300 or equiv.
S_1—2 pole 5 pos. CRL 2552 or equiv.
S_2—Part of L_6.

to twenty-five CFM is adequate. This may be supplied by a small fan or blower mounted so that at least 2½ CFM is forced up through the base of the tube. It is recommended that heat dissipating plate and grid connectors be used. All four socket terminals are used for the filament. Pins 2 and 3 are paralleled for one connection and pins 1 and 4 for the other connection. A suitable socket is the E. F. Johnson Co.'s number 123-211 or equivalent.

A B&W 551A coaxial switch is mounted on the rear of the unit. A long shaft and flexible coupling are used to bring this control out to the front panel. This allows the amplifier to be switched in or out of the circuit at will.

The 5 × 10 inch cutout in the center of the panel is covered with ¼ inch plexiglass. This cutout is of course optional and can be left to the discretion of the builder. However there is no better indication of resonance, or lack of it than the color of the plate.

For operating convenience all circuits are separately metered. The meters are mounted in a standard 5¼ inch meter panel which is

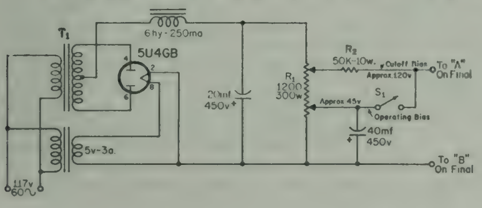


Fig. 2—A suitable bias supply for the final amplifier. An electronically regulated unit may be used rather than heavily load circuit shown above. Contacts S_1 are part of the antenna relay and are open on standby. Transformer T_1 should supply 800 v.c.t. at 250 ma.

placed above the amplifier.

To keep r.f. losses at a minimum all plate and pi-network connections are made with ½ inch copper strap.

If a center tapped filament transformer is available resistor R_1 can be eliminated. The plate current meter should then be connected to the transformer center tap.

Tune Up and Adjustment

The neutralization adjustment is made on 28 mc and will be correct for the other bands. Connect the output to a dummy load and set C_7 fully open. Apply reduced plate voltage and adjust the grid bias for a plate current of 80 ma. With loading capacitor C_9 fully meshed, slowly tune C_8 from minimum to maximum capacity. At one point the plate current will increase and grid current will flow. Using an insulated screwdriver adjust the neutralizing capacitor C_7 for zero grid current. Repeat this procedure with various settings of C_9. As a final check go through the above procedure with full plate voltage applied and bias reduced for a static plate current of about 160 ma. Caution, High Voltage!

The output from the exciter is fed to a tap on the cathode coil which represents 52 ohms. The location of the tap is contained in the coil table. However it may be checked as follows. Load the amplifier to about 1 kw input and peak C_6 for maximum drive. With a s.w.r. bridge connected between the exciter and amplifier, adjust the tap on the coil for a 1 to 1 s.w.r.

With C_6 set to mid capacity, the individual trimmers are adjusted for maximum grid drive at the center of each band. When changing bands it is only necessary to rock C_6 slightly for maximum drive.

With 2700 volts on the plate, grid bias should be adjusted for an idling current of 80 ma. This will be approximately 45 volts of negative bias. Checks made using a 2 tone generator and oscilloscope showed the following results. With idling current set to 80 ma no noticeable crossover distortion was evident. Crossover distortion became noticeable when idling current was lowered to 60 ma. If the amplifier is loaded heavy enough to hold single tone (c.w.) grid current to a maximum of 100 ma, no flat topping will occur. Flat topping became noticeable with light loading when grid current was allowed to exceed 120 ma. Loading is increased to the point where r.f. output just starts to drop off. At this point the grid current will be about 100 ma and the plate current about 450 ma. An r.f. output indicator was not included in the amplifier, nor has it been found necessary. However we have an s.w.r. bridge in the rack and monitor forward power.

The Bias Supply

Due to the large amount of grid current drawn by the 6C21 it is important that the bias supply have good regulation. This can be achieved by the use of an electronically regulated supply or by using a conventional supply that is heavily loaded. We used the latter, as shown in fig. 2, because husky surplus components were on hand. If this type of supply is used, bleeder current should be at least 200 ma. During standby the grid voltage is increased to about 120 volts. This is sufficient to drive the tube beyond cutoff. As can be seen in the schematic, cutoff bias is supplied to the grid of the 6C21 through resistor R_2. Contacts on the coaxial antenna relay short this resistor to the tap on R_1 which supplies the operating bias.

The positive terminal of the bias supply is connected to the filament center tap. This results in the plate current meter reading true plate current and not a combination of plate and grid current.

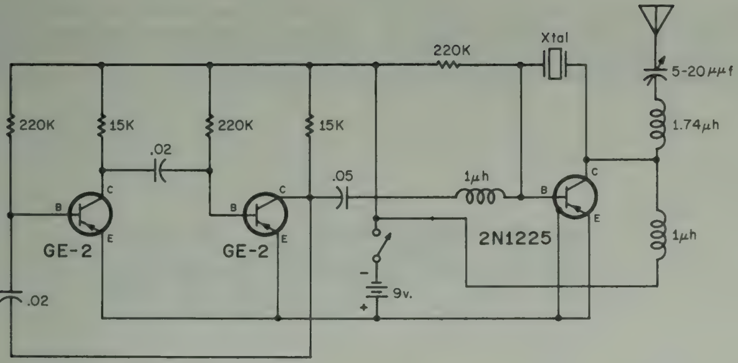
The Plate Supply

Any power supply delivering approximately 2500 volts at 400 to 500 ma is suitable for the plate supply. Ours is constructed of surplus components and delivers 2700 volts under load. We included an overload relay because one was on hand. This is a desirable feature but not at all necessary. Construction details are not included as the supply is conventional in every respect. Similar supplies will be found in any of the handbooks.

11 Meter "Sputnik"

I got to thinking one day how the Hams have their own "Oscar" satellite, the TV stations have "Early Bird," and Uncle Sam has scads of satellites. Why not CB'ers? We seem to have gotten the fuzzy end of the lollypop on just about everything else so why shouldn't we at least have a satellite of our own. So I built one.

Admittedly, it didn't get a very elegant launching because when I asked some of the fellows at the local airport if they would let me hang it from any of their private planes they giggled at me. Finally I was reduced to hanging the satellite from one of those big helium filled balloons they sell at kiddie parks. It slowly drifted skyward, sending out its raspy signal on Part 15 Channel B (27.045 mc/s). Without distance measuring equipment it was hard to tell exactly how high it reached before we lost its 50 milliwatt signal,



PARTS LIST

3	**220K resistors**
2	**15K resistors**
1	**.05 ufd capacitor**
2	**.02 ufd capacitors**
1	**5-20 uufd trimmer capacitor**
1	**crystal for 27.045 mc/s**
1	**1.74 uh choke (Miller RFC 144)**
2	**1 uh chokes**
2	**GE-2 transistors**
1	**2N1225 transistor**
1	**9 volt battery**
1	**SPST switch**
1	**38" whip antenna (Lafayette 99-G4001 or equiv.)**

Misc.: chassis, plastic ball, foam rubber, battery clips, hookup wire, launching balloon.

but it was several thousand feet!

A few days later the unit was picked up halfway across the state and returned to me—still in working order!

I'm passing along the design of my unit, you may wish to build one yourself. Even if you never launch it, it makes an interesting desk ornament which can be turned on and off and monitored on your own CB rig. It requires no license inasmuch as it operates under Part 15 low power rules.

CONSTRUCTION

I built it on a small piece of corrugated cardboard (to keep it as light as possible, but mainly because I don't have any chassis punching tools) which worked out fine and dandy. The layout of the parts isn't critical, but I kept all leads as short as possible.

The circuit was placed inside the "Sputnik," which was a hollowed out clear plastic toy ball (it originally came with a plastic duck floating in some water inside the ball). The ball was pried apart at the seam and the transmitter placed inside. The antenna, a short telescoping whip, was attached to the ball. I used only one whip for my rig, but the use of three additional unconnected whips would have made it *look* somewhat nicer.

After the transmitter was located inside the ball, I packed the ball with foam rubber to keep everything from jogging around, and also as protection during "landing."

TIPS

Use a miniature wire-lead crystal, soldering directly to the crystal wires. When soldering to the crystal and transistor leads, be sure to use a pair of tweezers or other heat sink a dissipate the heat so as not to damage the components. Be careful with battery polarity. Don't operate this on any of the regular Class D CB channels. The variable capacitor at the antenna should be rotated for maximum reading on an S meter or field strength meter—this adjusts the loading into the antenna.

To comply with FCC regulations, a certi-

CERTIFICATE OF COMPLIANCE WITH FEDERAL COMMUNICATIONS COMMISSION REGULATIONS, PART 15, PAR. 205

S9 Magazine certifies that this low power transmitting device can be expected to comply with the requirements of Paragraph 15.205 of the FCC regulations under the following conditions: (A) When this device is assembled according to the diagrams and instructions published by this magazine, using components of the exact specifications described. (B) When in use for the purpose and in the manner indicated in the instructions. (C) When operated on a frequency between 26.97 mc/s and 27.27 mc/s and using an antenna limited to a single element not more than 5 feet long.

Thomas S. Kneitel

Port Washington, N. Y. **Dated:** Sept. 1, 1966

I hereby certify that I have assembled and adjusted this device in strict accordance with the above.

Owner's signature. **Date:**

The finishing touch! To comply with FCC regulations it will be necessary for you to sign this tag, cut it from the magazine, and paste it.

fication of compliance with Part 15 *must* be attached to the transmitter. Such a certificate is given here and may be cut out and pasted to the chassis. It's a good idea to also include your address and telephone number if you are really going to send this thing into the wild blue yonder, that is if you ever hope to have it returned to you.

RECEIVERS

&

ACCESSORIES

1 Tube 40 Meter Regen

This is a two tube regenerative receiver band spread for forty meters. I could go on any band but I was taking the little Zipper Bag[1] transmitter which was already on 7 mc and 40 was what I needed at the moment. It has enough volume to make your ears say ouch and the regeneration control works smoothly and holds in across the entire band without any adjustment. There is no body capacity when touching the panel. A 6EB8 pentode triode is used and with this cathode type tube the microphonics are at a minimum. It will work on any plate voltage from 45 to 150 volts without too much change in volume or setting of the regeneration control. It does a nice job for a quick trip or picnic outing, and you will be surprised by how well it works.

Construction

The receiver is built on a 4½ × 2½ × 1 inch California Chassis and the power supply is built on a second identical chassis. The tuning capacitor is connected to a vernier dial by an insulated shaft. This prevents scratching noises when tuning, due to the dial mechanism.

The coil, for simplicity, is mounted on feedthrough insulators. The large bulk coil has higher *Q* than a small plug in type and gives better selectivity but plug in coils would work. The antenna winding is three turns of AirDux #1010 (or suitable hook-up wire) and it is placed at the end away from the ground tap. The antenna winding should run in the same direction as the main coil.

The regeneration tap is not critical and only needs be a few turns. Tapping of the coil to ground saves fussing around with polarity to make the set regenerate. Changing the tap only shifts the frequency which can be compensated by the trimmer across the tuning capacitor. Nothing is critical and the receiver should work the first try.

Testing

When you finish building the receiver set the band edge at zero on the dial by adjusting the trimmer across the tuning capacitor. Push the power supply at least one foot away from the receiver or you will pick up hum from the field of the transformer. Don't try to build the power supply on the same chassis. If you use batteries, use a Lantern type battery #941, Ray-O-Vac, and it will operate the filament a long time. Any small 45 volt battery will take care of the plate supply. Just don't get one of the tiny ones if you want it to last.

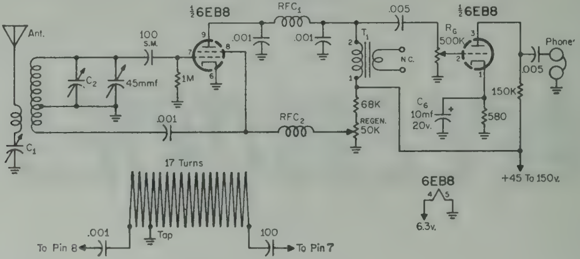


Fig. 1—Circuit of the 40 meter regenerative receiver. All resistors are ½ watt units. The two potentiometers are miniature types for space conservation. Capacitors greater than one in value are in mmf and less than one in value are in mf except where noted. Other than the one silver mica (SM) and one electrolytic the capacitors are all disc ceramics. The earphones are high impedance or crystal types.

C_1—25 mmf. Surplus from ARC-5 receiver.

C_2—35 mmf with all plates removed except for two rotor and two stator.

RFC_1, RFC_2—2.5 mhy, ferrite cores, J. W. Miller #6302 or equiv.

T_1—Any high impedance audio choke. A surplus transformer was used, 20K-600 ohms, available from J. J. Glass Co., 1624 S. Main St., Los Angeles, Calif. Marked Stancor 94138 GR-1CLA-FA-13. Cost, 35 Cents.

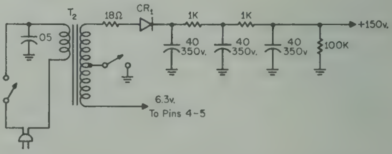
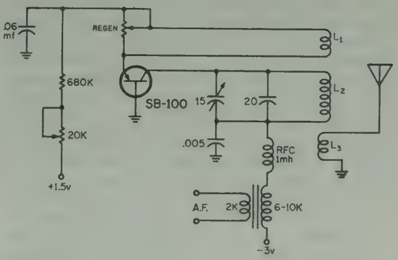


Fig. 2—Simple power supply used to power the 40 meter regenerative receiver. The power transformer provides 125 v.a.c. at 15 ma and 6.3 v.a.c. A Stancor PS-8415 or equivalent may be used. All capacitors are in mf and all resistors are one watt. The diode, CR_1, may be any unit with a 600 p.i.v. rating.

10 Meter Super-Regen

This circuit works extremely well. As a super-sensitive field strength meter it is excellent. You can connect an 0-1 milliameter in series with a silicon rectifier then connect this combination in the secondary of the output a.f. transformer; this works fine for field strength measurement purposes.



Simple regenerative receiver for 10 meters. The 20K pot may be replaced with an appropriate fixed resistor after initial adjustments have been made. Regeneration control R_1 is adjusted for maximum sensitivity on each received signal.

L_1—3t #22e. on hot end of L_2.
L_2—3 t #22e. 1" dia spaced over 1⅛".
L_3—2½t #22e. on cold end of L_2.

40/80 Transistorized Converter

The converter uses three Texas Instruments 2N1304 if built for 80 meters or 2N1306 if built for 40 meters. These transistors sell for \$0.62 and \$1.12 respectively. (Cheaper than tubes even!) For simplicity and compactness, the unit is built on a printed circuit board measuring only 2¼" × 3".

Figure 1 shows the schematic diagram which is almost self explanatory. The antenna is connected to a tap on the coil so that a low input impedance may be obtained to match the impedance of the mobile antenna. Incoming signals are fed to the base of the r.f. amplifier via a low impedance link, the low side of which is effectively grounded for r.f. by C_2. These signals are amplified by Q_1 from where they are fed to the mixer via two low impedance taps on the mixer coil and capacitor C_5. The use of taps on L_3 prevent it from being loaded too heavily by the low impedance of the transistor which would lower its Q considerably. The incoming signals are then mixed with a local oscillator signal which is injected in the mixer stage, via the emitter, from a low impedance link on the oscillator coil. The difference in frequency of the two signals is then fed to the broadcast receiver through C_8 The r.f. choke prevents the r.f. from being bypassed to the 12 volt line.

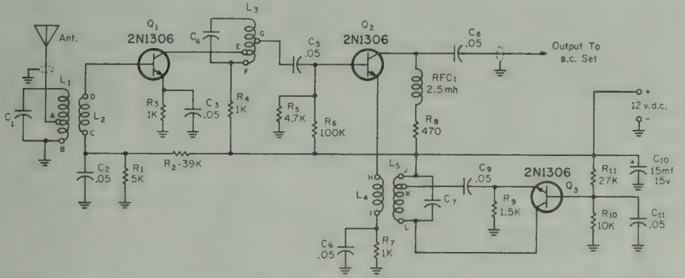


Fig. 1—Circuit of the transistorized 80 or 40 meter converter. All resistors are ½ watt and all capacitors are disc ceramics in mf unless otherwise noted.

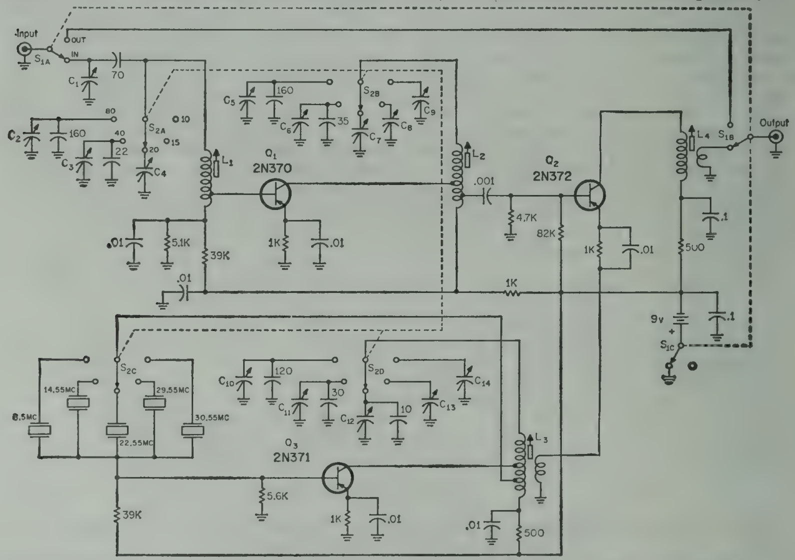
C_1, C_4—80 meters—100 mmf mica.
40 meters—30 mmf mica.
C_7—80 meters—120 mmf, silver mica.
40 meters—30 mmf, silver mica.
1—48t #26E on 5/16" dia. slug tuned form ¾" long, tapped 10 turns from ground end.
2—10t #26E wound over the center of L_1.
L_3—48t #26E on 5/16" dia. slug tuned form ¾" long, tapped 10 turns from F terminal and 12 turns from F terminal.
L_4—10t #26E wound over the center of L_5.
L_5—48t #26E on 5/16" dia. slug tuned form ¾" lona. tapped 8 turns up from L terminal.

The oscillator is a standard grounded base Hartley type. The feedback for sustained oscillation is obtained from a tap on the coil and fed to the emitter through C_9. Resistors R_1-R_2, R_5-R_6 and R_{10}-R_{11} combinations are voltage dividers to provide base bias for their respective transistors. Resistors R_3, R_7 and R_9 are current limiting resistors to prevent thermal runaway. Resistors, R_3 and R_7 are bypassed to ground by C_3 and C_6 in order that the r.f. and mixer stage may be operated in a grounded emitter configuration. Resistors R_4 and R_8 are for decoupling. Capacitor C_{10} is used to bypass any stray r.f. to ground and prevent feedback between each stage while C_{11} effectively grounds the base.

The antenna and mixer coils are first set to the approximate center of the band (either 80 or 40 meters depending on which is built) using a grid dip meter. The oscillator coil is then set to approximately 3000 kc for 80 meters or 6000 kc for 40 meters. The output of the oscillator is then monitored on a calibrated receiver and the oscillator frequency is adjusted to exactly 3000 or 6000 kc. Placing the oscillator on these frequencies will allow the broadcast receiver to give a more or less accurate indication of the frequency being listened to by adding either 3000 or 6000 kc to the receiver calibration for example 800 kc on the receiver will indicate 3800 kc for the 80 meter model while 1200 kc on the receiver will indicate 7200 kc on the 40 meters model. The antenna and mixer coils may then be peaked for maximum sensitivity while listening to actual signals on the band. It should be noted that if the unit is mounted in a metal box, the oscillator frequency will have to be readjusted when the installation is finished since the metal case will introduce more stray capacity in the oscillator circuit and will therefore lower the frequency.

10 thru 40 Mobile Converter

There is nothing particularly unusual about the actual circuitry. The three coils were optimized for the 15 and 20 meter bands, but work quite satisfactorily on 10 and 40 meters. An antenna trimmer is provided, but has little effect on any but the 40 meter band, and so could probably be



Circuit of a four band transistorized converter using the automobile broadcast receiver as tunable i.f.

C_1—2.5—15 mmf variable.

C_2, C_5, C_{10}—7-45 mmf ceramic trimmers.

C_3, C_4, C_6, C_7, C_8, C_9, C_{11}, C_{12}, C_{13}, C_{14},—3-13 mmf ceramic trimmers.

L_1-16t #26 e. closewound on ⅜" dia slugtuned form, tap at 3½t.

L_2-22t #26 e. closewound on ¼" dia slugtuned form, tap at 4 and 11 turns.

L_3—primary—14t #26 e. closewound on ⅜" dia slugtuned form, tap at 3½ and 7 turns. Secondary—1¾ t on cold end of primary.

L_4—Broadcast receiver antenna coil, slugtuned.

replaced by a fixed capacitor of the appropriate value.

The coils are tapped to match the transistor impedances at about 20 megacycles. The oscillator coil is tapped for both the input and output of the transistor, which increases the *Q* of the circuit and also its output. However the oscillator will also function satisfactorily when the collector is connected to the top of the coil. The output coil is a standard broadcast antenna coil connected backwards to match the impedance of the broadcast receiver input.

The oscillator is a transistorized version of the Pierce circuit.

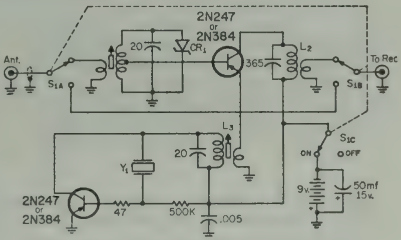
The 2N370 series transistors were used in the converter, but a somewhat better noise figure could probably be obtained on 10 meters with a 2N384 r.f. transistor.

If a milliammeter is available the transistors should be biased for 1 to 1.5 ma emitter current for the oscillator and r.f. stages, and 0.25 to 0.5 ma for the mixer. If no milliammeter is available the component values provided should be satisfactory.

Initial alignment of the converter was done with a grid-dip meter. Final alignment was made by connecting the converter to a broadcast receiver with the a.v.c. turned off, and feeding in a signal from an r.f. generator. The oscillator coil and capacitors were tuned to give maximum output. The r.f. and mixer coils and capacitors were adjusted in the same manner.

15 Meter Converter

This simple but very efficient converter may be used on other bands too—up to 50 mc. Nearly any good h.f. transistor will work in the circuit. L_1, L_2 and L_3 are slug tuned coils wound on National XR-91 forms. Although a Motorola zener diode is used for transistor protection from r.f. overloads, an NE-2 neon may also be used. The i.f. range (tuning) of this converter will be in the segments 650 to 1100 kc on your BC receiver. Keep coils L_1, L_2 and L_3 separated at least 1½". Coils should not be placed close to shields either (if used). The performance of the unit compared very favorably with a well-known manufactured tube model.



CR₁—Zener diode. Motorola ¼ MZ4AZ5.

L₁—12t. #18 e. on National XR-91 form. Tap 4t. from cold end. Link: 3½t. #18 e. at cold end.

L₂—Vari-Loopstick. Lafayette MS-11. Link: 12t. #18 e. at cold end.

L₃—12t. #18 e. on National XR-91 form. Link: 2½t. #18 e. at cold end.

S₁—3 pole 2 pos. rotary switch.

Y₁—3rd overtone crystal, 20.3 mc.

10 Meter Mobile Converter

Construction is simple and straightforward (see fig. 1). Use of fairly high *C* tuned circuits, sturdy coil construction and short leads augment stable operation. If possible, have the coils ventilated to prevent heat expansion. Isolate the input and output circuits to prevent undesirable direct coupling of broadcast stations. Coaxial cable inputs and outputs are mandatory from this standpoint. Since some auto radios use the input cable to tune the car radio antenna input circuit, it will sometimes be necesary to use a short low capacity output cable and the insertion of C_4 for adjustment of maximum signal strength during converter operation.

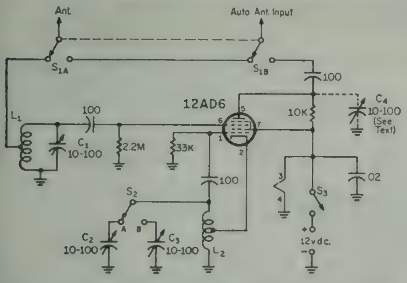


Fig. 1—Circuit of a converter for 12 volt operation that will permit a broadcast car radio to tune 10 meters in two segments, 28.5—29 and 29—29.7 mc. All capacitors are in mmf unless otherwise noted and all resistors are ½ watt. Inductors L_1 and L_2 are both 5 turns of #16 wire, ⅝" diameter, space wound ¾" long and tapped two turns up from ground.

Alignment of the converter is simple. With the converter off, readjust the auto radio input trimmer (if their is one) for maximum output, using any broadcast station on the high end as a signal. With the converter on and warmed up, adjust C_1 for resonance at 29 mc in the input circuit. With S_2 in the lower band position (A), adjust C_2 to resonate the local oscillator at 30.0 mc. Now with the auto radio tuning from 1500 kc to 1000 kc the band of 28.5—29.0 mc is covered.

Now place S_2 in the upper position (B) and adjust C_3 for 30.5 mc. local oscillator operation. Tuning the car radio from 1500—800 kc will now give operation from 29.0—29.7 mc. The signal can be peaked up by adjusting C_4 (if used) for maximum signal strength. If the radio does not have an input trimmer, C_4 may not be necessary.

10 to 80 Preselector

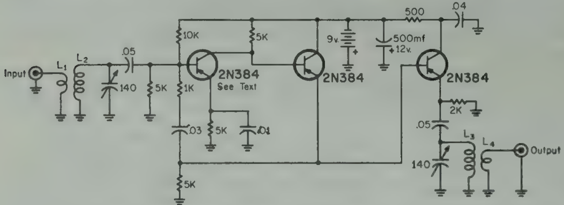
The important point in construction is to keep the output and input circuits isolated. I used 2N384 transistors but you can also use 2N2494, 2N2495, PADT-30, 2G401 or a 2N1516.

The tuned circuits are not critical and the unit will work down to 6 meters if the proper transistor is used for the frequency.

I suggest making yours in a Minibox so that shielding of output and input circuits can be accomplished with aluminum partitions.

The input impedance can be 50 or 72 ohms and the output Z can be adjusted to suit your particular receiver by varying the number of link turns on the output coil.

For low-loss I recommend using ceramic coil forms or no forms at all.



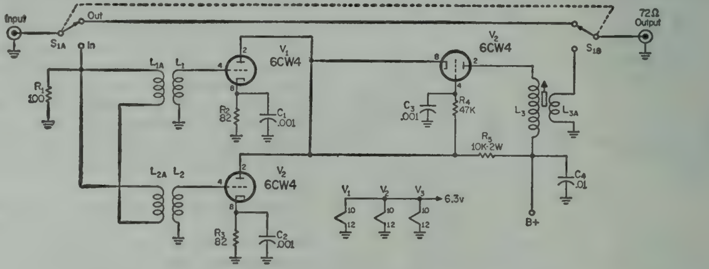
A simple transistorized pre-selector/signal-booster for 80 through 10 meters. If necessary, tap down on L_2 and L_3 for best signal-to-noise ratio. All resistors are ¼ watt and decimal value capacitors are in mf.

L_1, L_4—2 turn link, #18 cotton covered at cold end of L_2 and L_3. Vary turns for best operation.

L_2, L_3—Airdux 832T or B&W 3016 coil stock (32 t.p.i., 1" dia., #24 tinned wire). 80 m.—36 t. 40 m.—23 t. 20 m. and 15 m.—14 t. 10 m. 4 t.

Broadband Nuvistor Preselector

Inspect the winding of L_1 and note its winding direction. Coil L_{1a} is wound by removing the enamel from one end of a 20 in. piece of 30 enamelled wire, soldering the bared end to one of the two unused coil lugs, and adding 18 turns in the same direction as the original winding, starting at the base end of the coil form. From the top of the winding, run the wire down to the other unused lug on the coil form, cut the wire, clean off the enamel and solder the end to the remaining lug. Then spray the coil with Krylon so that the winding will not come loose.



Circuit of a 3 nuvistor broadband r.f. amplifier. All capacitors are in mf and are disc ceramics. All resistors are ½ watt unless otherwise noted.

L_1—North Hills 102C with core removed.
L_{1a}—18t #30 E. closewound on L_1.
L_2—North Hills 102F with core removed.
L_{2a}—34t #30 E. closewound on L_2.

L_3—North Hills 120E.
L_{3a}—7t #30 E. closewound on L_3.
S_{1a}, S_{1b}—Centralab wafers, XXD.

The winding of coil L_{2a} follows the same general procedure except that it requires 34 turns of a 40 inch piece of #30 wire. Similarly, coil L_{3a} requires 7 turns of a 10 inch length of #30 wire.

Remove the tuning slug from L_1 and L_2. The tuning slug in coil L_3 is turned in until it is flush with the bottom of the coil form.

Mount the coils on the chassis and proceed with the wiring as shown in fig. 1. All leads should be kept short.

A power supply of 6.3 volts a.c. at 0.4 amperes and 140 to 160 volts d.c. at 20 milliamperes is connected to the amplifier. This power usually is available from an accessory socket in the communication receiver.

For proper operation, the antenna system must present less than 100 ohms impedance to the amplifier input. A 72 ohm antenna cut for the desired band or a 72 ohm multiband antenna is ideal.

Output is fed through a 72 or 300 ohm lead to the receiver depending on the wiring arrangement used. A 300 ohm output adds an average of 6 db across the entire band.

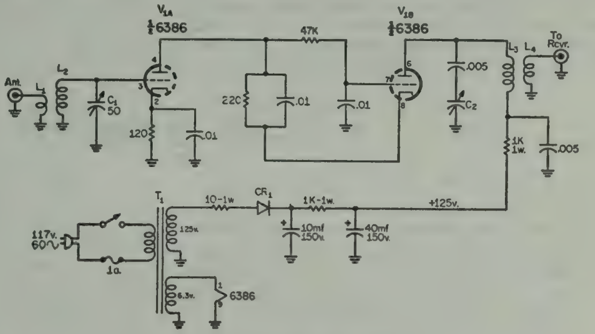
For 300 ohm operation unground L_{3a} and modify the switching circuit for 2 wires.

Cascode Preselector for 15 & 20

The pre-selector is built in an LMB Co. 5¼" × 3" × 2⅛" chassis, #136. No critical arrangement was used in the layout; the shield separating the antenna coil from the tube being used simply to keep the input signal from coupling across the tuned circuits.

Once the pre-selector is wired, adjust capacitors C_1 and C_2 for maximum signal on whatever frequency you are using in the 14 mc or 21 mc band.

If you desire to tap the antenna on L_2 instead of using L_1, the proper tap can be found by moving the lead until maximum signal is produced. The antenna can then be soldered directly in place. About 4 turns from ground should do it for a 50 ohm antenna. Inductor L_4 is coupled to the receiver through a short piece of coax and if the receiver has an antenna trimmer it should be peaked.



Circuit of a cascode pre-amplifier for the 15 and 20 meter bands. All capacitors with values greater than one are in mmf and less than one in mf unless otherwise noted. All resistors are half watt unless otherwise noted.

C_1—50 mmf APC type variable.
C_2—100 mmf APC type variable.
CR_1—400 p.i.v. diode at 50 ma. International SD-94 or equiv.
L_1—4t hookup wire on cold end of L_2.
L_2—16t Air Dux #816.
L_3—6.8 µh. Miller #21A686RBI, or 14t of #26 wire on ⅜" slug tuned coil.
L_4—2t. hookup wire for 50 ohm output. 4t. for 300 ohms.
T_1—125v. at 15 ma, 6.3v. at .6 a. Stancor PS-8415 or equiv.

CW/SSB Noise Limiter

Instead of the dual diode, 6AL5 tube, semiconductor diodes may be used, *but* they must have a high front-to-back ratio. This circuit is similar to the one contained in that real fine receiver, National's NC-303.

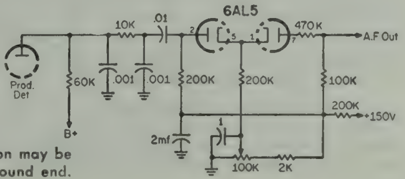
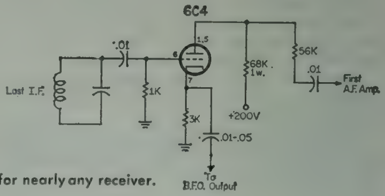


Fig. 1—S.s.b.-c.w. noise limiter. Clipping action may be removed simply by turning the pot to the ground end.

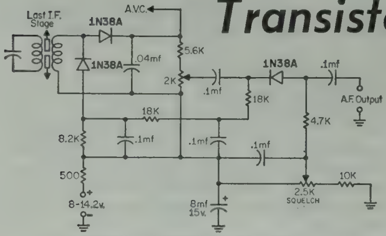
SSB Detector for Any Receiver

This can be a simple outboard device which does not disturb the set. Your regular detector can be switched in or out and the simple detector used, or not. A stable b.f.o. signal is required. This circuit will work with the following old receivers when the voltage to the b.f.o. tube is stabilized: SX-28, NC-183, SX-42, HQ-129, HRO-50, AR-88 and many others.



A practical s.s.b. detector for nearly any receiver.

Transistorized Squelch



Combination detector-squelch system designed to replace the original detector in a receiver. The diodes used are not critical, but should all be of the same type.

This circuit is a combination squelch-detector circuit. I suggest you use it as is, rather than trying to adapt the squelch portion to the detector in your set. The circuit shown is also capable of limiting noise via the diode connected in series with the capacitor connected to the center of the 2K pot. The squelch threshold is set by the 2.5K pot. The voltage applied to this circuit can range from 8 to 14.2 volts. Any good diode can be used where shown, however, be sure that they are of the same type.

1 Tube Squelch

Using a 12AX7 tube, the circuit shown in fig. 1 could not be much simpler and works very well. The threshold control is the variable 1K resistor in the cathode circuits of the triodes in the 12AX7.

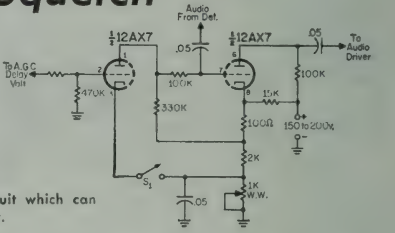
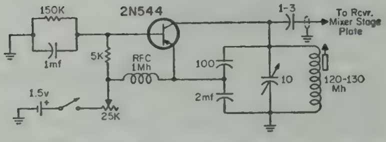


Fig. 1—Effective but simple squelch circuit which can be adapted to any receiver.

Q-Multiplier for 1400 kc IF

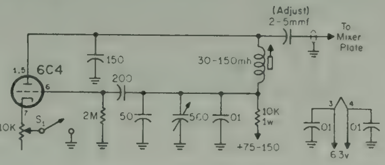


Transistorized Q-multiplier for i.f.s. in the 1400 kc region.

The lead to the plate of the mixer stage in the receiver should be shielded. The coil used should have a high *Q* and for 1400 to 1450 kc should be an iron core unit having a value of 120 to 130 microhenries. The resistor tied to the 25k Pot will have a resistance of from 3k to 40k ohms depending on the transistor used, and the value must be obtained experimentally. Try a 5k unit with the RCA 2N544 transistor. You can also try 3 instead of 1.5 volts before changing resistors. If you are fortunate enough to have a Philco 2N1742 transistor on hand it will work extremely well in this circuit.

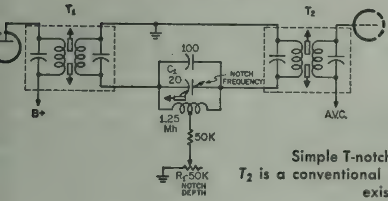
Q-Multiplier for 1500-1650 kc IF

This Q multiplier should meet your equirements. After installing check the i.f. alignnent of your receiver. I suggest that you mount he parts in a Mini-box for good shielding. Any oltage from 75 to 150 volts will work fine. Alhough a 6C4 is used in the circuit you can use f you desire, a nuvistor such as the 6CW4 or DS4.



Q multiplier for an i.f. of 1500 to 1650 kc.

T-Notch Filter for 455 kc IF



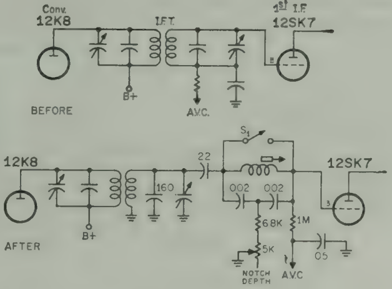
Resistor R_1 in the circuit is used as a selectivity and notch depth control. The variable capacitor shifts the notch in small increments.

Simple T-notch filter for 455 kc i.f.'s. Transformer T_2 is a conventional i.f. transformer, with T_1 being the existing 455 kc unit.

T-Notch Filter for BC-453

The TNF coil *L* can be any TV width or nearity coil from an old TV set. The capacitors cross the coil are disc ceramic types, and can ary in capacitance from .002 to .0033 mf. The otch depth adjustment can be quite critical. fter installation adjust coil *L* and the notch epth control (5k pot) alternatively while listeng to a heterodyne and leave the control set r maximum attenuation.

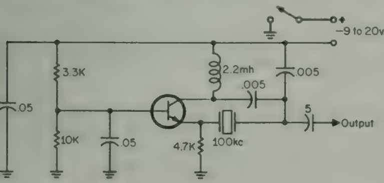
All parts were mounted in a cluster at the ft front of the BC-453. A shaft was made for tending the control (iron slug) of coil *L*. oil *L* itself was mounted on a bracket around e metering or headphone jack.



100 kc Crystal Calibrator

This is a circuit recommended y Texas Crystals using their in-stock TX100 crystal in a small HC6/U holder which fits a CE-1 socket. The price is only $4.50.

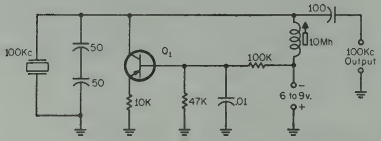
The operating voltage for the oscillator is not critical but should not exceed 20 volts. The voltage need not be stabilized but the frequency stability will be better if it is. You can use either a battery or voltage from your bias supply to power



Texas crystals 100 kc crystal calibrator. Transistor types 2N117, 2N160, 2N789, 2N902 or 2N332 may be used. Try a *small* variable capacitor across the crystal for fine calibration with wwv.

the oscillator. Be careful however, where you place the oscillator. Keep it away from high temperature areas. The output is connected via a 5 mmf capacitor to the *input* of the *receiver r.f. stage*. *Do not* connect it to the transceiver's antenna terminal which is used for both receiving and transmitting. The oscillator will enable you to check calibration every 100 kc.

Another 100 kc Crystal Calibrator



Transistorized 100 kc crystal calibrator.

Two Set Coupler for 10 thru 80

The unit has been used with two receivers without any interaction between the sets and seems to provide a lot more gain than when the receivers are connected directly (in tandem) to an antenna. The overall gain of both sets was appreciably higher on 7 and 21 mc than it was on the other bands. However, the lower noise and increased gain on 10 meters was well worth the effort putting the coupler together.

Note that the grids of the 7587 isolation amplifiers are in parallel, while their plate circuits are isolated from each other. Perhaps pentodes in these stages would make for better isolation. If you decide to try pentodes, be certain that the suppressor grid is connected to the cathode and that you use all of the isolation resistors shown.

Neutralization was found unnecessary. However, if you run into oscillation, any of the usual neutralization methods normally used in transmitter stages will work.

If additional receivers are used, all you need do is to duplicate the last isolation stage for each extra set. Just make sure that you have the required filament and plate power for the extra tubes available.

You can try tuning the secondary of the an-

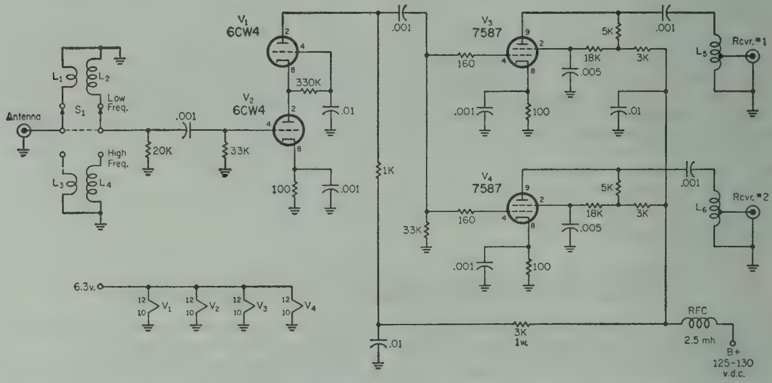


Fig. 1—Experimental receiving antenna multicoupler for 10 through 80 meters. Switch S_1 is set for best performance on the band in use. All resistors are ½ watt unless otherwise specified; all capacitors are in mf and are disc ceramics.

L_1—9 t. B&W #3011 Miniductor. Space 1t. from cold end of L_2.

L_2—40t. B&W #3011 Miniductor.

L_3—3t. B&W #3011 Miniductor. Space 1t. from cold end of L_4.

L_4—8t B&W #3011 Miniductor.

L_5, L_6—12t. B&W #3011 Miniductor. Tap 4t. from cold end.

S_1—2 pole 2 pos. ceramic rotary switch.

tenna input coil assembly for added gain by paralleling it with a variable capacitor of 250 mmf on 3.5 mc to about 50 mmf on 28 mc. Make certain that your inputs and outputs of the coupler are isolated mechanically so that there will be no feedback.

The input of this unit was roughly designed for 72 ohms, but if you wish to change to some other value, the link may be modified accordingly.

If your receivers have different input impedances, you can modify the coils in the outputs of the isolation amplifiers to match each receiver, but this will take a little experimentation.

You can use other coils instead of those suggested, but I found the B&W #3011 Miniductor (16 t.p.i. ¾" dia.) to work okay.

The plate and screen power for the unit should be well filtered, and, if possible, the plate voltage going to the 6CW4's should be regulated for best operation. Switch S_1 is a DPDT ceramic tap switch (two sections). Normal r.f. shielding is employed and the circuit layout did not seem critical.

The "Static Smasher" Noise Limiter

Here's a variable bandpass filter which, when connected between the speaker and audio output transformer of your CB rig, will substantially filter background noises and local interference from static, neon signs, fluorescent lights, motors, ignition noises, etc. While this gadget will remove these unwanted signals, it will cause weak voice signals to suddenly *pop* out of the hash and become readable.

There must be a compromise, however, and some of the audio fidelity will be lost from all signals, but, after all, we are mainly interested in communications, not in fancy sounds.

THE STATIC SMASHER

The STATIC SMASHER is operated by adjustment of the two switches, S_1 and S_2, which are the high and low frequency attenuators, respectively. This is done while listening to a station buried 'neath the noise, and the proper adjustment of these controls should produce the desired signal quality. For best results, the controls will have to be varied with each station tuned in.

CONSTRUCTION

Building the unit is a snap and should take only an evening's work.

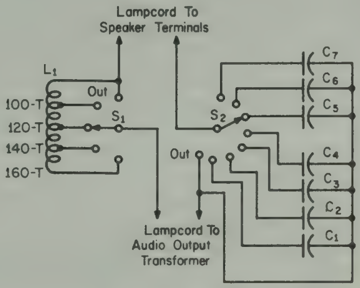
The coil, L_1, is wound on a ¾" wooden dowel about 1½" long and consists of 160 turns of #18 enameled copper wire. If you place cardboard discs at each end of the coil dowel, you will find that it will reduce the possibility of the coils slipping off the edge. When winding the coil, bring off taps at 100, 120, 140, and 160 turns.

The coil tap offs go to S_1, a 5 position switch.

The seven capacitors may be of any type with better than a 25 volt rating. If electrolytics are used, it doesn't make any difference which polarity is which way. The capacitors are connected to S_2, a 12 position switch.

For both S_1 and S_2, the "out" (off) position bypasses the STATIC SMASHER if you don't want to use the unit.

Because of the fact that the STATIC SMASHER removes part of the audio from the signal being received, expect that it will cut down the volume from the loudspeaker.


Lampcord To Speaker Terminals
L1
Out
100-T
120-T
140-T
160-T
S1
S2
Out
C7
C6
C5
C4
C3
C2
C1
Lampcord To Audio Output Transformer

PARTS LIST

C_1	**15 ufd (Centralab DD30-150)**
C_2	**10 ufd (Centralab DD30-100)**
C_3	**5 ufd (Sprague TVA 1203)**
C_4	**2 ufd (Sprague TVA 1301)**
C_5	**1 ufd (Sprague TVA 1300)**
C_6	**0.5 ufd (Sprague 2TMP50)**
C_7	**0.1 ufd (Sprague 2TMP10)**
L_1	**160 t. #18 enam. copper wire ¾" diam. on 1¼" long form. See text.**
S_1	**5 pos. non-shorting SP rotary (Mallory 3215J)**
S_2	**12 pos. non-shorting SP rotary (Mallory 32112J)**
	6 x 5 x 4 chassis (Bud CU-3007A)
	lamp cord, knobs for switches.

"Signal Snatcher" Nuvistor Preselector

The noise generated within a receiver, and not that coming in on the antenna, is the limiting factor in CB receiver sensitivity. The more gain an RF amplifier stage provides for a given amount of noise generated, the better will be its weak-signal performance. Tube performance falls off as we go higher in frequency and the RF amplifiers have to be run "wide open" to produce enough gain to make these weak signals audible. There is still a lot of external noise, but much of the "hiss" that is characteristic of a "hot" CB receiver is tube noise, generated within the receiver itself.

For the reception of weak signals, it is desirable to have as much gain as possible ahead of the mixer stage of your regular receiver. This would insure that the signal level would be strong enough to completely override the noise from this stage. In general, the best signal-to-noise ratio can be obtained from a receiver when the first RF stage or stages are operated at maximum gain. It should have provision for control of overall gain of the stages. For good signal-to-noise ratio, one must strive for high gain RF amplification, exclusive of regeneration. Two stages of grounded-grid RF amplification (as used in this model) are better than the cascade circuit using these same tubes. The gain per stage is low, hence the two stages. The noise figure is lower than anything on the market and is extremely stable.

Using two 6DS4's, with their remote-cutoff characteristics, helps reduce co-channel interference. The gain control in the second stage helps tremendously when a strong signal comes on the band. Nuvistors, as used in this circuit, just loaf along. By now, you should be sold on the virtues of Nuvistors and

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PARTS LIST

C$_{1,3,6,8}$	**5 uufd. disc ceramic capacitors, 500 volts**
C$_{2,4,5,7,9,10,11}$	**.001 ufd. disc ceramic capacitors, 600 volts or more**
R$_{1,3}$	**68 ohm, ½ watt resistors**
R$_{2,5}$	**18K ohm, 2 watt carbon resistors**
R$_4$	**1000 ohm pot, IRC Q11-108**
V$_{1,2}$	**6DS4 Nuvistors**
J$_{1,2}$	**Coax connectors (UG-274 or SO-239)**
	Nuvistor sockets (2) Cinch 133-65-10-003)

COIL TABLE

Wind all coils on Cambridge Thermionic CTC-LSM (white slug)

L$_1$ 18 turns #30 enam. Tap at 7 turns from ground end.

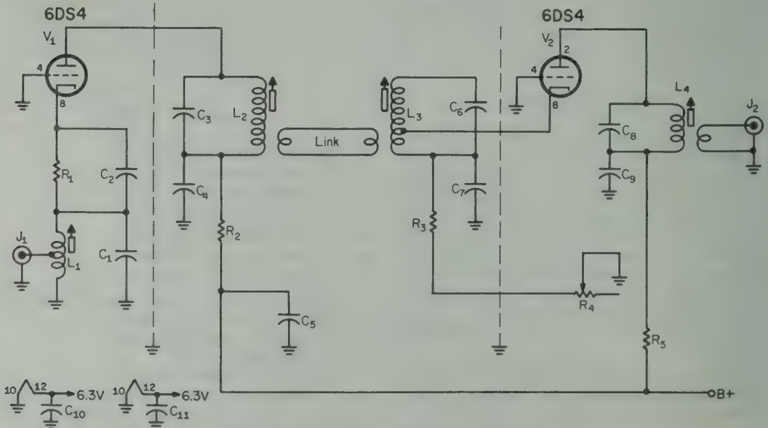
L$_2$ 18 turns #30 enam.

L$_3$ 18 turns #30 enam. Tap at 6 turns from ground end.

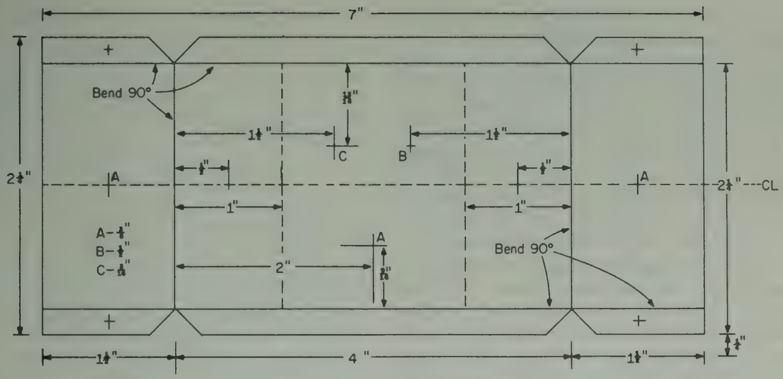
L$_4$ 18 turns #30 enam.

Interstage coupling link: 1 turn of #22 plastic insulated hookup wire.

Output link: 2 turns #22 plastic insulated hookup wire.



Schematic of The Signal Snatcher, Mark II.



Chassis plan of the Signal Snatcher.

as time goes on, will probably be seen as standard equipment in all commercial CB equipment.

As shown in the schematic the preamplifier is known as a cascaded grounded-grid RF amplifier. Actually, the preamp will provide more than enough gain, even for the most conscientious CB'ers, striving for that *last* ounce of performance. The circuit is straightforward and no difficulty should be encountered if you follow the circuit, drawings and construction outline.

The cathode of each stage taps on the coils to provide the best "mismatch" to achieve the best noise figure. The bandpass circuit between stages permit higher "Q" tuned circuits, resulting in better image rejection and a more uniform response than would be possible with capacitive coupling.

LET'S GET TO WORK!

Although there are many ways one could lay out a preamplifier circuit, we elected to build this model on a slightly longer and wider chassis box than in the original model. This type of construction allows easy access to all the components during wiring and testing. Again, it should be emphasized to follow closely the drawings so as to obtain the same results.

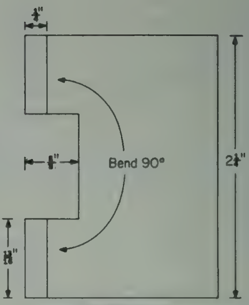
1. Layout the main chassis box and shielding members as shown in figure 2.
2. Drill mounting holes for coaxial connectors, tube sockets, coil forms, shields, and gain control.
3. Bend chassis (starting with the outside flanges) and shield partitions.
4. Wind coils L_1, L_2, L_3, L_4. Be sure to provide tap points on coils L_1 and L_3 as outlined in coil table.
5. Wire capacitors C_1, C_3, C_4, and C_5 across coils.
6. Mount Nuvistor sockets, coaxial connectors, and all coils.
7. You'll find it an easier job if you wind the interstage coupling link and output link before making any connections to the coils. The links should be wound in the same direction as the other windings and at the top of the coils.
8. Wire R_1 and C_2 to the cathode (pin 8) (solder) of the input tube. Keep cathode leads short.
9. Mount filament bypass capacitors C_{10} and C_{11} to pins 12 on both sockets (crimp at socket). Solder the free end to the chassis.
10. Solder tap on the input coil (L_1) to center post of the coaxial connectors nearest pin 8 on the socket.
11. Solder bottom of the above coil to chassis.
12. Solder the top of the input coil to R_1 and C_2 (cathode resistor and bypass capacitor).
13. Solder bottom of plate coil (L_2) to pin 2 of the first stage.
14. Mount shield partitions to separate input and output of first stage.
15. Mount gain control (R_4) so that leads are facing inward to sockets.
16. Bend and solder middle lug of gain control to chassis.
17. Solder tap on coil L_3 to pin 8 of second stage Nuvistor.
18. Mount and solder capacitor C_7 to chassis.

19. Mount and solder resistor R_3 to left hand terminal of gain control.

20. From top of plate coil (L_4), wire in the plate dropping resistor (R_5) and the plate bypass capacitor C_9. One end of this cap. goes to chassis ground. Since most CB base stations use tube models and operate from a built-in power supply that puts out about 250 volts, the plate dropping resistors (R_2 and R_5) can be 18K ohms @ 2 watts.

21. Mount second shield partition.

If you use flashing copper for the chassis and shields, the metal work should be completed up to the point where the parts are ready to assemble on the chassis. The copper may be polished with steel wool. The outside of the chassis box can either be sprayed with a clear finish or a finish to match your receiver. This prevents an oxide coating forming over a period of time.



Internal shield dimensions.

If signals are used to set up the preamp, they should be peaked for *greatest rise over noise* for a given signal, rather than maximum "S" meter reading or the loudest volume.

All tuned circuits can be set with a grid-dip meter or can be pre-set to channel 9.

Tune Up A La 1629 Magic Eye Tube

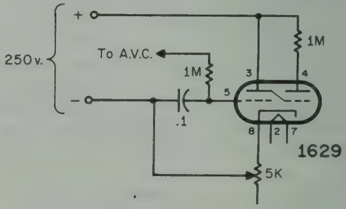
Here's yet another use for the type 1629 "magic eye" electron tube—this time we use it as sort of an S-meter, or tuning meter. As you tune in a station with your receiver, the eye of the tube begins to close. Maximum closing of the tube indicates that the station is properly tuned in. Often you will find that by properly tuning in a station you'll be able to cut interference and also hear stations further away. At any rate, the pretty green light sure looks nice, even if you don't care much how you tune in a station.

Another use we have found for this gadget is to use it for *quiet* monitoring of Channel 9, the National CB Calling & Monitoring Channel. Luckily, Channel 9 isn't cluttered up with a lot of jibberish and nonsense—when the channel is used, 9 times out of 10 it is a lost or stranded motorist, or else it's someone trying to contact a local who cannot be found on his usual channel. Anyway, I like to monitor 9, but my communications receiver doesn't have a squelch and the background noise is just out of this world and makes it impossible to monitor a dead channel for more than ten minutes at a time without my going batty. Now, since I've installed this 1629 tube, I can flip the set onto 9 and turn down the volume. I just glance over at it from time to time—if the eye is closed that means that someone is on the channel. If I'm not busy, I turn up the volume. Even if I had a squelch I would prefer this system because there is nothing as annoying to me as trying to get a message through on one channel while the standby set is blasting my ear off with one of the other locals calling someone or giving road aid.

Anyway, I'm sure that you will be able to use the 1629 for these and any number of other uses.

CONSTRUCTION

The tube is mounted in an Amphenol type 58-MEA-8 assembly, and the few components in the circuit may be easily attached to (or near) the socket of the assembly. The



PARTS LIST

1	**5 K pot (optional)**
2	**1 Meg. ½ watt resistors**
1	**.1 mfd capacitor**
1	**type 1629 tube**
1	**Amphenol 58-MEA-8 assembly**

assembly may be housed in a small *Mini Box* or mounted on the front panel of the receiver with which it is being used.

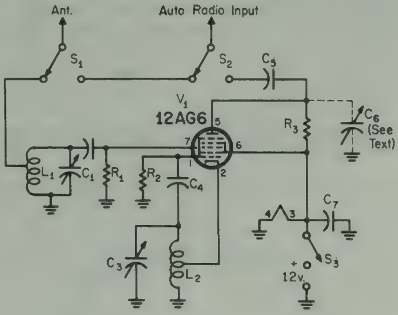
A pot is included in the circuit as an optional feature, you can use it to vary the amount of closing of the "eye." If you omit this from the circuit it won't diminish the operation of the circuit.

Pin 5 of the 1629 tube, the grid, is connected to the AVC voltage of the receiver, which may be picked from the grid of the DC amplifier, indicated on equipment schematic diagrams, or it can be pointed out to you if you bring your schematic to any CB service shop. The B+ voltage is 250 volts, the filaments receive 12 volts.

CB Converter for 12 Volts

The circuit consists of a heavily coupled tuned antenna input circuit to the converter, with a fixed local oscillator frequency. The plate circuit is untuned allowing the use of any standard broadcast receiver (especially a car radio) to be used as a variable IF amplifier/receiver, and thus a means of tuning over the band. By using this form of conversion, the stability problem is kept simple (fixed local oscillator), construction effort down (no front panel dial to worry about), and costs are reduced (no variables or IF output transformer). Furthermore, the use of a 12AG6 twelve volt space charge tube eliminated the B+ supply without the necessity of resorting to transistors, with their higher costs and design problems.

Construction is simple and straightforward. Use of fairly high C tuned circuits, sturdy coil construction and short leads augment stable operation. If possible, have the coils ventilated to prevent heat expansion. Isolate the output and input circuits to prevent undesirable direct coupling of broadcast stations. Coaxial cable inputs and outputs are mandatory from this standpoint. Since some auto radios use the input cable to tune the car radio antenna input circuit, it will sometimes be necessary to use a short low capacity output cable and the insertion of C_6 for adjustment of maximum signal strength during converter operation.



PARTS LIST

$C_{1,3}$	**10-100 uufd capacitors**
$C_{2,4,5}$	**100 uufd capacitors**
C_6	**10-100 uufd capacitor (see text)**
C_7	**.02 uufd capacitor**
R_1	**2.2 Meg. resistor, ½ watt**
R_2	**33K resistor, ½ watt**
R_3	**10K resistor, ½ watt**
V_1	**12AG6**
$L_{1,2}$	**5 t. #16, ⅜" diam., space wound ¾" long. Tapped two turns up from ground.**
$S_{1,2}$	**SPDT toggles**
S_3	**SPST toggle**
Misc.:	**chassis box, tube socket.**

ALIGNMENT

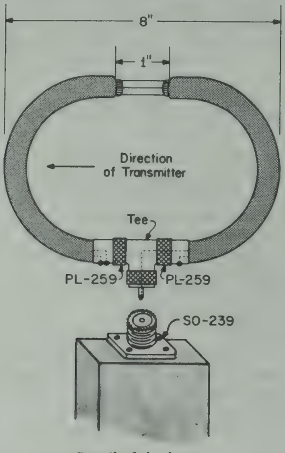
Alignment of the converter is simple. With the converter off, readjust the auto radio input trimmer (if there is one) for maximum output, using any broadcast station near the low of the band as a signal. With the converter on and warmed up, adjust C_1 for resonance at 26 mc/s in the input circuit. Adjust C_3 to resonate the local oscillator at CB Channel 1. The Citizens Band will now appear across your broadcast dial, from the low end of the band up towards the center. The signal may be peaked up using C_6 (if used) for maximum signal strength. If the radio has an input trimmer, C_6 may not be necessary.

Easy calibration may be accomplished by means of a signal generator. First tune your auto radio to 965 kc/s, then locate CB Channel 1 there by means of C_3. Then (with the exception of Channels 1 through 3) it will only be necessary for you to add a 27 and a decimal point to the last three digits to determine the CB channel to which you are tuned. If your car radio reads 1*085* kc/s, you will be on 27.*085* mc/s, or Channel 11. By this method you will also have your CB channel pop out between broadcasting station channel, and this should cut down on the possibility of them feeding through the converter to interfere with CB reception.

The "Sniffer" Direction Finder

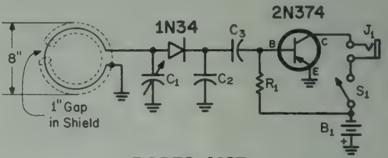
The only two electronic components of any consequence in the circuit are the 1N34A (30¢) diode and the RCA 2N372 (80¢) transistor. It's really a snap to build, and just about any size box will do—I used a Bud CU-3003-A (4" x 2¼" x 2¼") *Minibox.*

The loop is made from a length of RG-8/U coaxial cable. A 1 inch swath of the cable's copper shielding is removed to form a gap at the top of the loop—this is important. Male PL-259 coax connectors are attached to each side of the loop as they both fit into a "tee" connector. One side of the loop is connected to the PL-259 in the standard manner, but in the other, the shield is shorted to the center conductor, so that the PL-259 at that end has no connection to its center prong. While it makes for a lopsided circuit, it gives a nice bi-directional null reading as well as an easily readable maximum reading when the grounded side of the loop is pointed towards the transmitter being sought.



Detail of the loop.

High impedance headphones are used with the circuit, and we found that a hearing aid type earphone (such as Lafayette's *Argonne* AR-46, which sells for $1.39 and includes the matching miniature jack receptacle) was convenient and didn't take up much space when storing the D.F. SNIFFER. Be sure to insulate the headphone jack from the metal case.



PARTS LIST

C_1	**35 uuf midget air capacitor (Hammarlund MAPC-35)**
C_2	**.005 uf capacitor (Sprague TG-D50)**
C_3	**.1 uf capacitor (Sprague 192P10492)**
R_1	**150 K-ohm, ½-watt resistor (IRC GBT-½ 150K)**
B_1	**3 volt battery (RCA VS-148 Mercury type)**
S_1	**SPST toggle (Cutler-Hammer 8280-K16)**
J_1	**headphone jack, as applicable**
Misc:	**2 PL-259 coax connectors, 1 "Tee" coax connector, 1 SO-239 coax receptacle, RG-8/U coaxial cable, hookup wire, high impedance headset or earphone, 1 1N34 diode, 1 2N372 RCA transistor, Bud CU-3003-A Minibox.**

HINTS

Put a strip of white tape around the "grounded" side of the loop so you will be easily able to determine which side of the loop is pointing to the station being heard.

At the 1 inch gap atop the loop, leave the white poly coax insulation remaining over the center conductor. The gap may be covered over with *Scotch Brand* electrical tape to protect it and to improve it's appearance.

Peak up the unit by means of C_1. Because it is relatively insensitive, you will pick up only signals in the immediate vicinity of your D.F. SNIFFER (about a mile or less). You can peak it up on your own transmitter on Channel 9, which should be adequate for just about any station you will ever monitor. Peak for maximum signal strength as monitored in the headphones, but better stay a few hundred feet from the transmitter so that you don't overload the D.F. SNIFFER. By the way, if you hope to track down anybody with this thing in the immediate area of a broadcasting station, forget it—the station will saturate the D.F. SNIFFER's circuit.

Razor Blade Radio

Does it work? Ask any ham who was a dogface in Korea or World War II. We used to build these things in fox holes and could get reliable reception for 25 miles or more, depending on the complexity of the antenna and ground system used. If you want to have some fun; plus building a real pioneering type piece of "electronic gear" at *no* expense, why not put together the RAZOR BLADE RADIO, it could be the first of a long series of electronic gadgets you will build (as it was for me).

CONSTRUCTION

The schematic for our receiver is shown in Fig. 1. It will be recognized as that of a simple diode detector connected to a pair of headphones. So much for electronics (we don't want to scare you off).

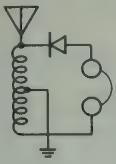
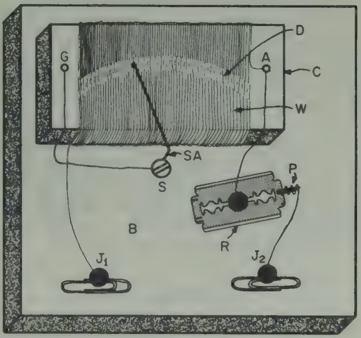


Fig. 1. Schematic of the Razor Blade Radio.

The actual design of the receiver is shown in Fig. 2. If you follow its simple layout you should have no trouble getting fired up in an hour or so.

The longest antenna possible and a cold water pipe ground should really pull 'em in. If a long antenna isn't possible, try hooking the antenna lead to the chrome finger-stop on a telephone dial.



The detector is the piece of pencil lead wrapped with copper wire, resting lightly on the razor blade. Some adjustment of the location and pressure of the pencil lead on the blade may be required. We always used a double edged blade, so we can't tell you if a single edge job will work—but it *won't* work with an electric razor as a substitute. Also, for any wise guys out there, you won't get "sharper reception" with a new blade (anyway, nobody in a fox hole saw a new blade for months at a time, in fact, many were the times when the radio had to be dismantled at shaving time).

So have fun, I hope that this little project will show you how simple it is to get started in electronic construction (without getting yourself into a lather, hi hi).

PARTS LIST & INSTRUCTIONS

A—This is a nail which is used as the antenna terminal, and also for holding the coil form to the baseboard.

B—The baseboard, a piece of wood (plywood or soft pine is OK) ¼" thick, 4" square.

C—Coil form, ¼" wood, 3¾" long, 2" wide.

D—Area of coil which will be touched by "SA," this should be scraped clean of insulation along the movement area at the tip of "SA."

G—This nail is used for the ground connection and to fasten the coil form to the baseboard. It is also connected to "S."

J—Two copper paperclips which are used as jacks for the headphones. They are held in place by thumb tacks.

P—Pointed piece of pencil lead, wrapped with copper wire which is attached to J_2. The wire should be resilent enough to hold the lead in place on the blade (see text).

R—Razor blade held down by a thumb tack. Also attached to the tack is a wire which runs to the antenna terminal, "A".

S—Screw or nail which is used as the pivot for "SA," the switch arm.

SA—The switch arm, which is made from an opened up paper clip. Moving "SA" back and forth along "D" will enable you to change stations. Tune slowly and adjust "P" as described in the text for maximum results.

W—Coil winding on "C." This is approximately 175 turns of #26 insulated wire. One side is connected to the antenna terminal, the other side is connected to J_1.

Misc.—Wire; pair of 1,000 to 2,000 ohm headphones.

1 Transistor SW Receiver

This little receiver won't break any worldwide DX records, but it will permit you to get a look as what's going on around the megacycles for about a $3 or $4 investment (or less if you have a well stocked junk box). It should drag in shortwave station within a radius of several hundred miles, and do it surprisingly well. I was able to obtain coverage from 2.5 through 8 megacycles on it, and that includes several ham and international broadcast bands, plus marine and aviation bands. I constructed the receiver using a small metal box as the chassis.

COILS

Different coils provided full frequency coverage, these were wound on 1¼" diameter coil forms. I used number 28 enamelled wire with the following number of turns for the different bands covered:

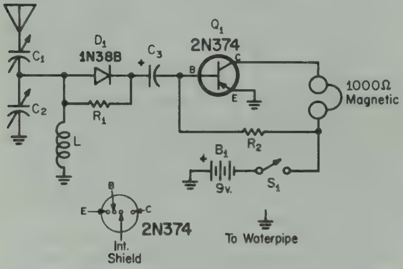
28 turns = 3 to 4 mc/s
14 turns = 4 to 8 mc/s

OPERATION

Capacitor C_1 allows you to peak the antenna, while C_2 changes the stations. The antenna should be an outside long wire, and make it as long as possible. The circuit should be grounded, as indicated on the schematic, to something like a cold water pipe. I suggest that you experiment with different values of R_2 to obtain best operation of the circuit, try values from 100K to 1 Meg—or install a 1 Meg. pot in the circuit here.

Be certain that you carefully observe proper battery polarity.

You can experiment with different coils for additional frequency coverage, more turns give lower frequency coverage, less turns give high frequency coverage.



PARTS LIST

C_1	**150 uuf variable**
C_2	**100 uuf variable**
C_3	**10 uf, 12 v. electrolytic**
R_1	**220 K resistor**
R_2	**220 K resistor (see text)**
L	**see text**
B	**9 volts**
Q_1	**2N374 transistor**
D_1	**1N38B diode**
S_1	**SPST toggle**

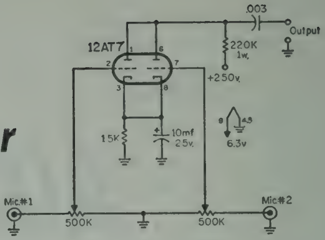
Pair of 1K ohm magnetic earphones, chassis box, coil forms, knobs for $C_{1,\ 2}$

AUDIO

&

MODULATION

Simple Mike Mixer



More Audio for Your Mobile

Many mobile rigs suffer from the same problem, inadequate audio output from the modulator. A simple method of increasing the modulator output without an extensive modification is to regulate the modulator screens.

My mobile rig, using a pair of 6L6s, was modified as shown in fig. 1. With only the series resistor, R_s, the screen voltage would vary under modulation. With no audio, the screen current would be low resulting in a high screen voltage when least needed. Under modulation the screen current would rise thus lowering the screen voltage when most needed.

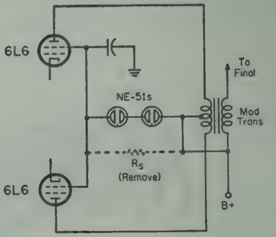
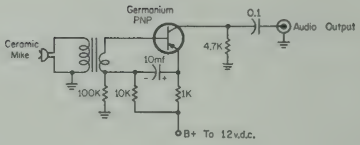


Fig. 1—Substitution of the two NE-51s for R_s results in increased audio output.

A simple approach, as mentioned, is series regulation. A pair of NE-51s in series proved to be just right for the 6L6s. The neon bulbs tend to keep the screen voltage very nearly constant over a fairly wide range of screen current. While the average current limit of the neon bulbs is low they are capable high peak currents.

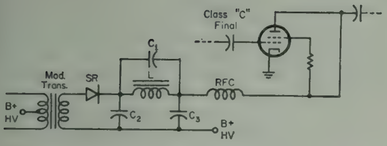
Modulator tubes other than 6L6s require different configurations. Two NE-51s in parallel worked fine for a pair of 6AQ5s operated at 300 volts. For a larger rig, using a pair of 6BQ6s in the modulator, a VR150 did the trick. In an s.s.b. linear with a plate supply of 800 volts we used two VR150s and one VR105, all in series, to hold the screen close to 300 volts. The efficiency improved greatly in all cases.

1 Transistor Mike Preamp



A transistorized mike preamp delivery about 20 db gain.

Speech Clipper



High level speech clipper. See text for values.

This is a high level clipper. Presuming that you're using a 6146 final and running the tube at around 600 volts at 100 ma, your plate load would be around 6000 ohms. In this case, use .5 henry for *L* and .006 mf for *C*2 and *C*3. For *C*1 use about .005 mf. The coil *L* should be capable of handling 600 volts at 100 ma. Be safe and increase this by 25%. The selenium rectifier can be any type that handles a p.i.v. over 600 volts and around 200 ma or so. This gadget *works!*

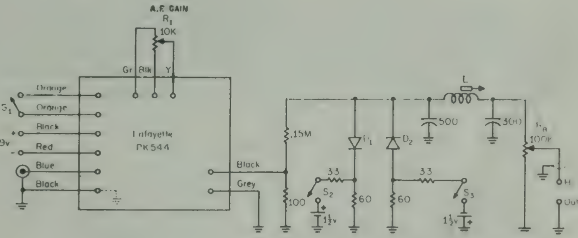
Make certain that the capacitors used will handle the working voltage.

Transistor Speech Clipper

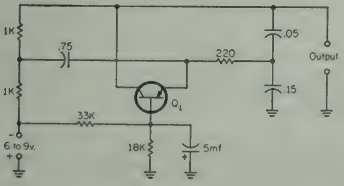
The speech clipper uses a Lafayette PK-544 packaged transistorized amplifier, which has an output of 360 milliwatts. It sells for $6.95. Any amplifier having similar input (high-*Z*) and output (low-*Z* . . . 8-11 ohms) characteristics may be used in the clipper. With the ready-made amplifier however, making the clipper is only a matter of about 1½ hours. We thank Stan Isaacs of Lafayette for allowing us to use the info printed here.

It is suggested that the output elements be installed in a shielded case. As K6AI suggests, "the simplest way to adjust the clipper is as follows: (1) connect mike to input jack, (2) connect an oscilloscope or an a.c. v.t.v.m. to the output terminals to read output voltage, (3) close switch S_1-S_2 and S_3, (4) set R_8 for maximum output, (5) set R_1 so that the faintest whistle into the mike gives output voltage of approximately 1 volt. Note that a loud whistle then produces the same output voltage. R_1 now needs no further adjustment, (6) connect the output terminals to the input of the main amplifier in the transmitter, and, with the main amplifier gain control set to its normal position for 100% modulation of the transmitter, set R_8 for 100% modulation without overload distortion."

Fig. 2—A clipper using a packaged amplifier. "L" is a 20 Henry adjustable inductor. D1 and D2 are germanium diodes. The output of the unit must go to Hi-Z input of 500K or more. The wires of the amplifier are color coded for easy identification.

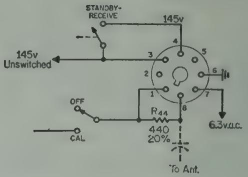


1 kc Transistorized Audio Oscillator



Transistorized 1 kc oscillator. Q_1 may be a 2N1175, 2N632, 2N324 or 2N109.

1kc SSB Alignment Oscillator

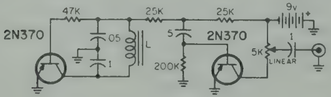


Corrected version of schematic of calibrator socket in the new National NC-190.

2 Transistor Audio Generator

This little a.f. generator using transistors works like a charm. Its output waveform is excellent.

The inductance L in the emitter of the first transistor can be a good iron core choke or the primary of nearly any output transformer (2000 to 6500 ohms or so). The capacitors across the inductance may be varied in value (along with the latter) to give you the frequency you want. I suggest that you keep the ratios of capacitance of the two condensers as is and vary the size of L.



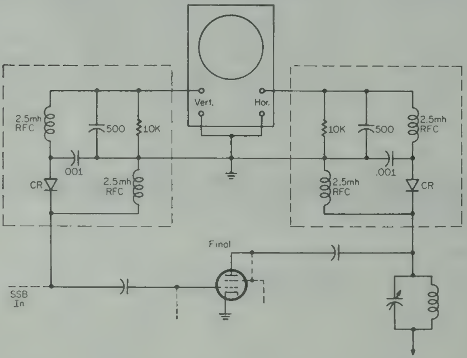
A.F. signal generator

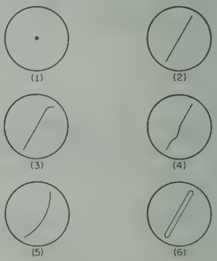
Transistors other than 2N370 (as shown) that can be used are: 2N105, 2N283, 2N371, 2N372, 2N373, 2N374 and CK-722.

SSB Monitor

This circuit enables constant monitoring of a voice signal as well as short two-tones tests. The envelope detectors required can be constructed in a metal box if you remember to isolate each one.

With the two-tone test your patterns, of course, will be more clearly defined, but with voice modulation you can still tell when your amplifier is flat-topping and perhaps putting out a distorted signal. Input to the horizontal section of the scope may be taken from any linear stage preceeding the final amplifier.





S.s.b. monitoring by use of two envelope detectors shielded from each other. Diodes (CR) are matched RCA IN445Bs.

Phase Modulator for VHF

MANY VHF HAMS HAVE AT ONE time or another wanted to try their hand at VHF p.m. operation. If you are one of these fellows, then take a look at this. First I would like to point out that this particular rig is not complete in itself as a transmitter, but is rather an adapter that can be added to any 2 meter rig to permit p.m. operation without impairing other modes of operation.

Now let's get on to the diagram, as can be seen in fig. 1. The crystal oscillator is nothing out of the ordinary. It is, in fact, a modified Pierce-type of oscillator. The triode half of the 6U8 is used as the phase modulator and deviation is set by capacitor *CN*. Maximum deviation will be attained at maximum capacity. No attempt to multiply in frequency should be made in either the xtal oscillator or in the phase modulator, as frequency "swing" at the resultant output frequency will be down. Frequency multiplication should take place only after the phase modulator stage.

I don't believe that much has to be said about the audio section except that deviation is also controlled by the audio gain control and you may not have to build the stage at all. You may be able to steal the audio from the speech preamp stage in the a.m. section of your rig. The reason that I built up the audio stage was so that I could go from p.m. to another mode of operation merely by turning down the gain control in the phase modulator unit.

In my 2 meter unit I simply removed the old crystal oscillator and built the p.m. unit in to the rig and now I utilize the PM osc for all modes of operation. I would also like to point out that I did not include coil specs because there will be some who will want to put this adapter on 3 mc, 6 mc, & 8 mc to multiply to 2 meters, and I also feel that anyone who constructs VHF gear has the technical ability to come up with the appropriate coils.

The resistor divider network in the control grid of the triode half of the 6U8 is called an audio correction network and performs the following function: When a phase modulator is employed, the equivalent carrier frequency "swing" is in proportion to the amplitude of the audio signal. Rises in the audio signal frequency cause further undesired phase shift in the carrier. The unwanted rise in phase shift is removed by the use of an RC network to lower the amplitude of the audio signal in proportion to the frequency increase.

In this particular circuit a deviation of ± 7 kc was attainable with the trimmer *CN* at full capacity, and the audio gain control "wide-open". I have had this adapter on for about three months with very good reports so get out the soldering iron and good luck on 2 meter p.m.!

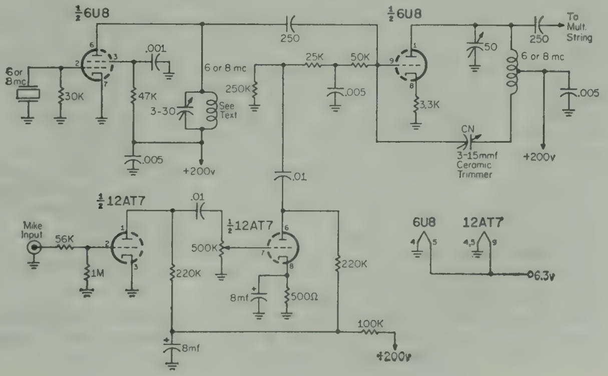


Fig. 1—Schematic of the phase modulator as constructed by the author for 2 meter operation. Coil specs are not included, as you may want to use this unit for other bands (see text). All resistors are ½ watt.

Screen Grid Modulator

I built my modulator in a 3 × 3 × 5" minibox and had enough room to add a preamplifier stage at the time, if one was desired. It was found in my case that I could very easily overmodulate causing splatter and distortion if I opened the gain too far. The characteristic of this system is carrier controlled modulation, or more simply, power output on modulation peaks.

It might be noted at this time that the system halves the input to the final, and, if difficulty arises, try reversing the lead to the high voltage, to the screen grid, and vice versa.

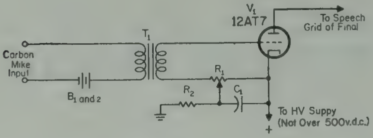


Figure 1—Schematic diagram of WA6NFI's little modulator. This device provides more than adequate "punch" for the average v.h.f. transceiver or low powered transmitter.

$B_{1,\ 2}$—1½ v. penlite batteries.

C_1—.01 mfd 1000 v. disc ceramic.

R_1—20K, 1 w. potentiometer.

R_2—100K, ½ w.

T_1—Standard carbon mic. transformer.

V_1—12AT7.

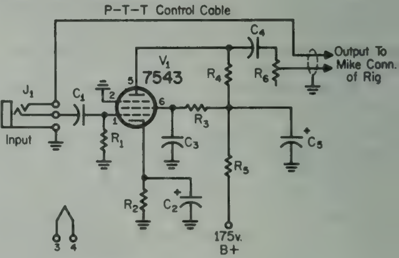
1 Tube Mike Booster

Want to "computorize" *your* audio? Here are some hints on putting this simple preamp together, and it *is* simple; nothing complicated about it. First of all, *don't* ask me to send you our "worn out" tubes, I can't do it. You can buy a *brand new* 7543 tube for about $1.55 from most tube distributors.

The circuit was built in a Bud CU-3001-A small *Minibox,* although any metal chassis will do. The preamp requires 6 volts for the filaments and about 150 to 175 volts for the B+. I suggest that you take the B+ at the output of the filter capacitor (the second one after the rectifier(s)) of your CB rig. Observe proper polarity for the two electrolytic capacitors in the preamp circuit.

Resistor R_6 is a pot which establishes the output volume of the preamp, and this *must* be initially adjusted and set only by a qualified and licensed technician (so that you won't overmodulate and run afoul of the FCC). The output of the preamp was piped into some mike cable (directly from R_6) and thence to the input jack on the CB rig.

At the input of the preamp, I used a Switchcraft type 12B jack (J_1), a 3 connection "open circuit" jack which would permit me to retain the push-to-talk operation of my mike. The connector on the mike was then changed to a Switchcraft type 60 plug to mate with the 12B jack. The mike used, of course, was a high impedance type—and the preamp may be used with any crystal or ceramic mike.

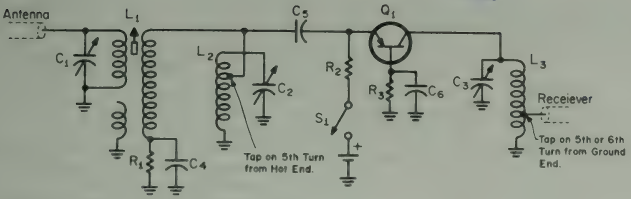


C_1	**.01 capacitor**
C_2	**25 ufd electrolytic, 25 v.**
$C_{3,\ 4}$	**.05 capacitor**
C_5	**20 ufd electrolytic, 450 v.**
R_1	**2.2 Meg., ½-watt resistor**
R_2	**1K resistor**
R_3	**200K resistor**
R_4	**100K resistor**
R_5	**22K resistor**
R_6	**500K potentiometer**
J_1	**3 conductor OC jack (Switchcraft 12B or equiv.)**
V_1	**7543 tube**
Misc.:	**7 pin tube socket, chassis, mike cable, hookup wire, mike connector.**

Poor Man's Preamp

A lot of the inexpensive units have no RF amplifiers, but a five dollar bill (you'll get some change) and an hour of effort can work wonders with your set. Here's how.

This unit has three tuned circuits to reject signals on nearby channels and a transistor amplifier to boost the input signal level. While the layout of parts is not critical these



Antenna
L1
C1
C5
Q1
L2
R2
C2
R3
C6
C3
L3
Receiever
S1
+
R1
C4
Tap on 5th Turn from Hot End.
Tap on 5th or 6th Turn from Ground End.

PARTS LIST

C1, C2, C3	3-30 mmf Trimmer capacitor
C4	.01 mf capacitor
C5	100 mmf, 50VDC disc Capacitor
C6	.01 mf 50VDC disc Capacitor
L1	Lafayette HP-66 Antenna Transformer
L2, L3	1 megohm @ 1 watt, #24 enameled wire (see text)
R1	1000 ohm @ 1/2 watt
R2	470 ohm @ 1/2 watt
R3	33000 ohm @ 1/2 watt
Q1	RCA 2N1178, 2N1179 or 2N1180 Transistor
Sw	1 S.P.S.T. switch
Batt	1 1/2 volt pen cell and holder
Misc	Perforated phenolic board, 6x3 inches. Transistor socket, heat sink. 4 feet RG-58/U coax

few suggestions should be followed. Take the three trimmer capacitors and mount them as far apart on the perforated board as possible. Use a transistor socket to install the 2N1178. Twenty five cents for the socket is a lot cheaper than the cost a new transistor to replace the one you burned while soldering. A piece of string will hold the antenna ransformer securely if you choose to lay it on its side. Don't use wire, it confuses the lectrons.

With these tips in mind, let's wire the unit. Start from the left side of the schematic and work toward the right. After mounting the hree trimmers and the antenna transformer oush the transistor socket through the board omewhere between the second and third uned circuits. The coils L_2 and L_3 are easy o wind so don't worry if there's a little space between the windings. The range of the trimmer is large enough to compensate. L_2 has 23 turns wound on a 1 watt, 1 megohm or igher resistor. Scrape the enamel from one nd of the wire and solder to the resistor ead close to the body. Wind five turns and wist a half inch tall loop. Then add the other 8 turns and solder the wire end to the other esistor lead. L_3 has the same number of urns L_2 but has no loop. After winding the oil, locate the fifth and sixth turns from the round side and scrape off enough enamel or a good solder connection. Install L_2 and L_3 on the board close to their respective trimmers and complete the rest of the wiring. Before installation double check the board for good solder connections and proper wiring.

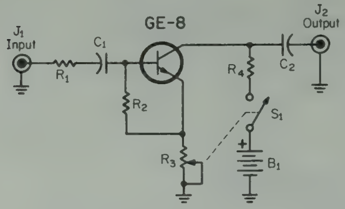
The unit is wired to the set through short lengths of RG-58 coax cable. Pull the bottom plate off your rig and locate the push-to-talk relay, relay tube or switch. Find the wire that goes to the first tuned circuit of your receiver and remove it. Now take the coax marked "Antenna" and solder the center lead to the relay where the wire was. Connect the braid to the chassis. Next, take the coax marked "Receiver" and attach the center lead to the same lug on the first receiver tuned circuit where the old wire was. Button up the set and tune to your local call channel.

Taking one of your wife's emery boards or a non metalic tuning tool, adjust L_1 and C_1 for peak signal. Then tune C_2 and C_3 for peak signal. Jump back and fourth between these two since there is some interaction which will effect tuning.

What you will hear is not a booming increase in the volume of strong stations since the receiver AVC circuit limits their strength. But you will hear a very noticeable increase of the more distant locals. This is especially true of mobile units where antennas are shorter in length and lack a good ground plane.

The "Band Blaster" Preamp

Using a ($1.26) GE audio transistor, the ircuit can give varying degrees of gain all he way up to 40 DB—which will give you a mighty big sound on the channel. Built it in a 1½" by 2" by 2½" *Minibox*. R_8 varies the gain to the best audio level to suit the occasion. The jack, J_1 and J_2, can be any type needed. Plug the mike into the input, the output goes into the mike connector on the CB rig.



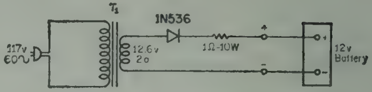
PARTS LIST

$C_{1,2}$	1 ufd capacitors
R_1	68,000 ohm resistor
R_2	150,000 ohm resistor
R_3/S_1	10,000 potentiometer with switch (Lafayette VC-28 or equiv.)
R_4	100,000 ohm resistor
J_1/J_2	use the same type connectors now on your mike and rig
B_1	22.5 v. battery (RCA VS-084 or equiv.)
Type GE-8 audio replacement transistor	
Bud CU-3000-A Minibox chassis	

POWER SUPPLIES

12 Volt Charger

It takes about one week to fully charge a dead battery with the charger shown. Since the charger does not take much power it may be left on continuously without costing much. It does not have to be disconnected from the battery when the power is off, since the diode blocks the discharge path. Battery charge condition is best checked with a hydrometer.



Circuit of a half ampere charger permitting a 12 volt battery to be used for bench testing. The transformer, T_1, is a Stancor P-8130 or equivalent.

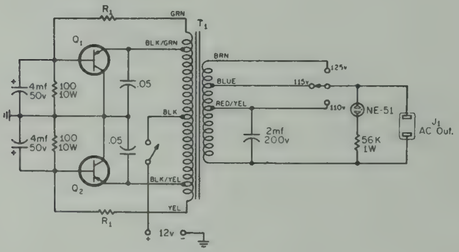
Caution must be used with a storage battery. If ventilation is poor, hydrogen gas may form and explode from a small spark. The acid also presents a hazard. It is very corrosive to metal, and damaging to wood and clothing. A bottle of bicarbonate of soda and water may be kept close by to neutralize any spilled acid.

Mobile Inverter

The grounded collector circuit allows the transistors to be mounted directly on the chassis. The most important part of the unit is the heat sink. The plain chassis shown provides the minimum area for sufficient heat dissipation, *providing* a very good contact is established between the transistor case and the chassis. To aid this contact the transistor and the chassis should be coated, in the contact area, very lightly, with Dow silicon grease. The transistor should be tightened down hard with the largest screw driver you have, and then tightened even more with a larger, borrowed screw driver. Your transistors will last about 10 seconds without a good heat sink. The chassis should be mounted to the car with a large area of bare metal to metal contact for additional heat sink. For the larger unit, (TY-75) a larger chassis, or better still, a commercial heat sink and the larger 2N277 or 2N441 transistors should be used. Two additional straps at the rear of the chassis will help support the weight of the transformer at the rear; these will depend on how and where you mount the unit.

I_{dc} In	A.C. out	Load	Eff. %
2.4 a.	140 v.	0 w.	0
3.8 a.	135 v.	18 w.	40.2
4.8 a.	127 v.	32.2 w.	56.0
7.0 a.	115 v.	60.0 w.	71.0

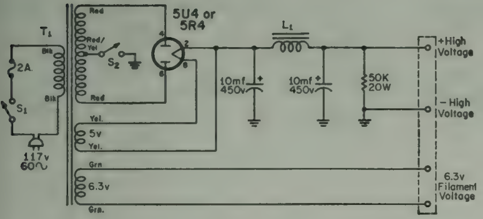
On heavy loads, such as a 60 watt light bulb, the starting current may be many times the full load current, due to the cold filament. In this case the unit may not oscillate. If it does not, the transistors can overheat. This unit will start with a 50 watt cold load, but not a 60 watt cold load. A neon indicator will tell you whether the unit is oscillating. The frequency is 64 c.p.s. at no load and 56 c.p.s. at full load. The table gives the efficiency of the unit under various loads, and the output voltage at the 115 volt tap. The output is almost a square wave. A 10 microhenry choke will help bring it closer to a sine wave if necessary.



Q_1, Q_2	R_1
Bendix 2N677	4Ω-2w
Clevite 1514	5Ω-2w
Delco 2N277	4Ω-2w
Delco DS506	7Ω-2w

Circuit recommended by Triad for a 115 v.a.c. power supply using their transformer type TY76A. Any of the listed transistors may be used with the proper value of R_1 as shown in the chart.

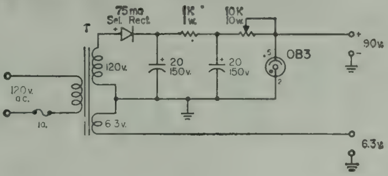
Beginner's Power Supply



Schematic of a simple power supply suitable for construction by the beginner. Transformer T_1 is described in the text or may be a Thordarson T-22R06. S_1 is the a.c. On-Off switch while S_2 is used to turn the high voltage on and off. Filter choke L_1 is discussed in the text.

6.3/90 Volt Power Supply

Transformer T can be any good transformer having a 120 volt secondary at 50 ma or more and contain a filament winding for 6.3 volts at ½ to 1½ amps (depending on the number of tubes used). Adjust the wire wound 10K pot for 90 volts output.



6/12/150/250/325 V. Power Supply

The first thing in the construction of a power supply of this sort is to decide the requirements and then select the transformer to supply those requirements. Don't be stingy with the power transformer's size and power output. It should have a good safety factor. I used an old TV transformer that supplied 340 volts at 350 ma with 5 volts at 6 amperes and 12 volts center-taped at 6 amperes. This would power almost any low-powered unit and the receiver and converter at the same time.

I used replacement 200 ma filter chokes from old television receivers which are available from some companies at three for a dollar. Use good capacitors, not dried up surplus units. Good new capacitors cost only a little more and they do a better job of filtering.

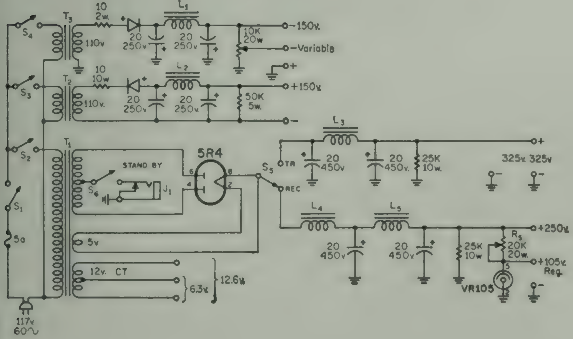
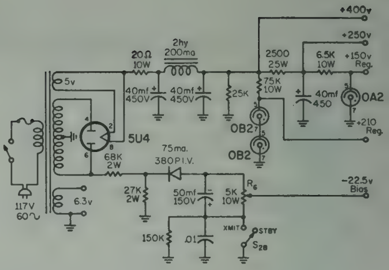
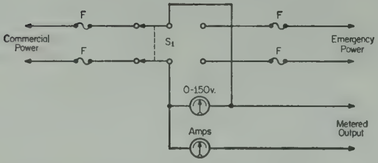


Fig. 1—A general purpose power supply. See text for details.

All Purpose Power Supply



System for Monitoring Voltage



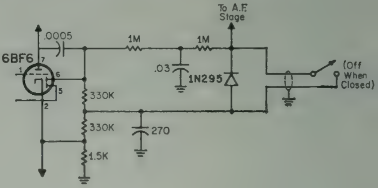
Simple control system for monitoring voltage and current from commercial or emergency power source. Switch S_1 is a heavy-duty d.p.d.t. knife switch. Fuses are determined by the anticipated load current.

MODIFICATIONS

Noise Limiter for Drake 2A

This limiter is quite effective. Diodes that have low front-to-back resistance will not work as well as the one recommended—the better the diode, the better the n.l. action.

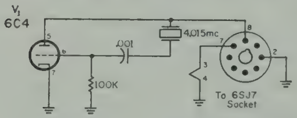
Instead of using an extra switch you can use the ACC switch on the receiver. This limiter has been used with great success by a number of W6 hams.



3251 & 75A4 Sidetone

It can be done by coupling the sidetone output of the 32S-1 through a .001 mf capacitor to the top of the volume control (connection farthest from ground). If not enough sidetone comes through with the .001 mf condenser, a .01 mf capacitor can be used with success.

32V2 Conversion for 4 mc MARS



Plug-in adapter for the 32V-2 enabling operation on 4015 kc for MARS. The 6SJ7 oscillator tube is removed and replaced with the plug-in circuit shown.

A plug-in unit is constructed using a 6C4 tube to be plugged into the socket of the 6SJ7 oscillator tube. The dial on the transmitter is set at 4000 kc and perfect performance is obtained on 4015 kc.

32V-Series TVI Cure

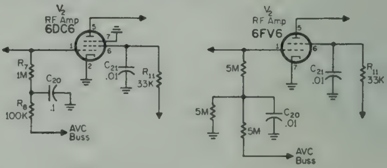
Owners of the Collins 32V series transmitters will be interested to know of one strong source of TVI. It is the r.f. choke, L_{403}. It is located behind and above the 4D32 final amplifier tube. Because it is parallel to the final r.f. amplifier coil, L_{401} there must be some mutual coupling. W8CTI, Chief Engineer for Bud Radio of Cleveland suggests that the old fashioned r.f. choke be removed and a heavy duty r.f. choke such as Bud's CH-568 or National's R-175A, be utilized.

Mounting the choke is no problem. It can occupy the position of the old L_{403} with one or two additional mounting holes or it can be mounted via the screws of the final plate current meter, M_{302}.

75A4 Modifications

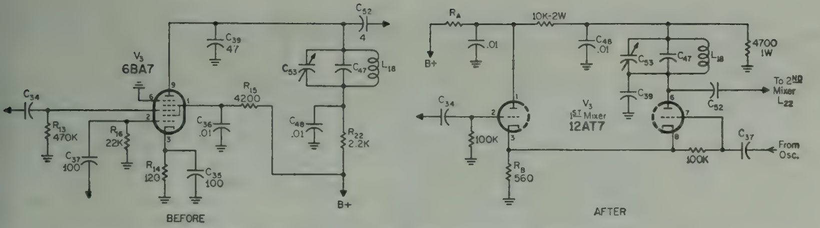
One department in which the 75A-4 has been in need of some help is the audio section. Although quite adequate for communication purposes, it leaves something to be desired in the quality department. Modifications needed to improve the audio are quite simple. Remove R_{71}, 33K from V_{18} and replace R_{109}, 390K with 750K.

For greater i.f. gain, remove R_{40}, 22K from across



BEFORE AFTER

Fig. 1—Modifications to the r.f. amplifier of the 75A-4. Change the 6DC6 to a 6FV6 and make the grid grid circuit changes shown.


BEFORE

AFTER

Improved first mixer circuit for the 75A-4. First mixer is changed from a 6BA7 to a 12AT7 with the circuit changes shown. Resistor R_A is adjusted for 150 volts on pin 1 of the 12AX7. Resistor R_B can be between 100 and 1000 ohms with varying results

L_{27} and remove R_{29} from across L_{24}. These changes are not new and have been tried previously with inconclusive results.

The change of the second mixer from a 6BA7 to a 6U8A as outlined in our column in June 1960 is worthwhile and we can recommend this modification from our own experience. If the mixer changes are not contemplated, check screen voltages on the 6BA7 mixers. They will probably show 150 to 170 volts. Tube manufacturers maximum ratings are 100 volts. Increase the values of the screen dropping resistors to get 100 volts.

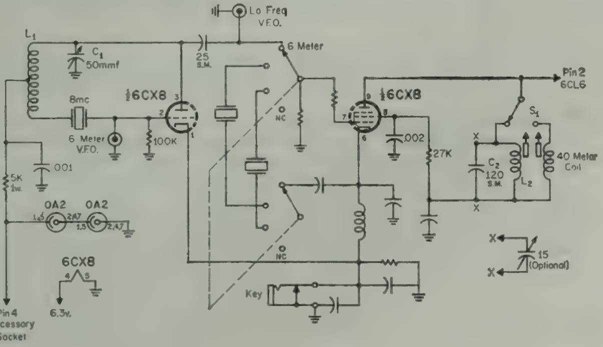
More 75A4 Modifications

Replace V_5 the 2nd mixer which was originally a 6BA7 and substitute a 6U8A to obtain a lower noise figure. A little rewiring is necessary but is worth the effort. Replace V_2 the r.f. amplifier (originally a 6DC6) with a 6BZ6. Better sensitivity is realized. No rewiring is necessary. Just substitute. Replace V_{17}, a 5Y3 with a silicon diode rectifier combination to reduce heat. TAB has the inexpensive unit. S.s.b. and c.w. reception will be improved and more i.f. gain obtained by simply removing one end of resistor R_{46} which is across i.f. transformer L_{27}. This resistor is used to de-Q the i.f. transformer and its removal very slightly degrades a.m. but the additional peaking attainable with its removal is worth the trouble. The side-tone monitoring signal of the Collins S-line or Heath Marauder can be coupled through a 10 mmf capacitor to the hot side of the volume control R_{62} or to pin 7 of V_{13}.

DX-40 On 6 Meters

First he changed the 6U8 I suggested to a 6CX8. To make the LSM-30 coil prescribed in the article resonate at 25 mcs, a 120 mmf silver mica capacitor was placed in parallel with it. Two 0A2 v.r. tubes were added to stabilize the oscillator voltage. In the 6CL6 circuit the pi-wound choke was removed and a Z-50 substituted, this stopped a resonant condition encountered.

One turn was removed from the new final



The oscillator driver section of the DX-40. Capacitors not marked, are the original ones in the set.

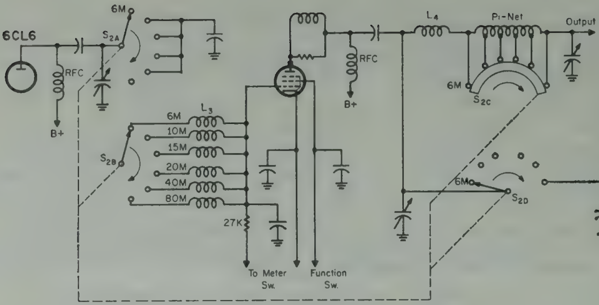


Fig. 3—The driver-final section of the DX-40. Capacitors not marked are the original ones in the set.

L_1—14t B&W #3003 tapped 4½t from xtal end.
L_2—Cambion LSM 30.
C_1—50 mmf ceramic trimmer.
C_2—120 mmf Silver Mica.
S_1—s.p.d.t. ceramic switch. Mount L_1 on terminal strip for rigidity. Use xtal socket on extreme left of chassis (viewed from below) for 8 mc xtal. Rewire other socket to right side of chassis.
L_3—9t #18e, ½" long, ¼" dia.
L_4—2t #18e, ⅜" long, 1" dia. (Airdux 808T).
$RFC_{1,2}$—Ohmite Z-50.
S_1—4 standard Centralab ceramic switches, (3) type XD and (1) type FFD sections mounted on switch detent assy. type PA, approx. 6" long. This can be matched with a little ingenuity to existing switch assy.

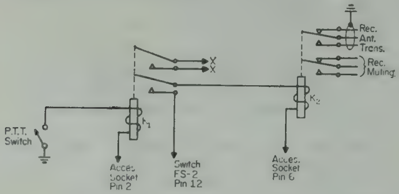
plate coil, the new coil now has 2 instead of 3 turns. The .425 mh choke in the plate circuit of the 6146 final was shorted out.

He found that the LSM-30 coil would not provide sufficient drive over the entire 50 to 54 mc spectrum so he installed a midget 15 mmf variable capacitor across the coil and 120 mmf capacitor combination.

It is recommended that at least #20 solid copper hookup wire be used for making connections. Vince also recommends that the small mica capacitor from the junction of the 47K and the 47 ohm resistors to the cathode of the 6CX8 be removed.

DX-60 Push-To-Talk Circuit

This set up uses two relays. When the mike button is pushed, 6 volts a.c. is appled to K_1 thus feeding 110v.a.c. to relay K_2 and completing the high voltage supply circuit. A toggle switch may be installed in parallel with the mike switch and front panel mounted for c.w. operation or tune-up purposes. The relays may be mounted in any convenient location, but *not* close to r.f. or a.f. wiring.

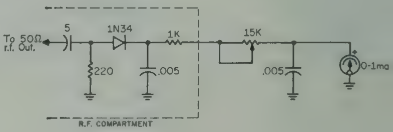


Push-to-talk circuit for the Heath DX-60 transmitter. The center tap of the high voltage transformer is broken by relay contacts X-X. K_1 may be any 6 volt a.c. relay with proper contact arrangement while K_2 is a 110 volt a.c. Dow-Key antenna relay with auxiliary contacts.

DX-100 Output Indicator

K6BYR sends in his version of a good r.f. output indicator for the DX-100. The pot is placed next to the meter providing external control and is used to adjust for maximum desired indication on the band used. If operation is mainly on the lower bands (80-40 meters), it may be desirable to use a 7 or 10 mmf in place of the 5 mmf unit shown. The 5 mmf is adequate for use on 20 through 10 meters. The DRIVER CURRENT position of the meter switch was utilized, inasmuch as it is not often used on s.s.b. as is the DX-100 of K6BYR. Thanks OM.

R.f. output indicator used by K6BYR on his DX-100. The DRIVER CURRENT function of the DX-100 meter is removed and replaced with the circuit shown.



DX-100 or Viking QRP on 160 M

Now that the 160 meter band is open for operation in all states, a lot of amateurs are trying to operate their DX-100's and king transmitters at reduced input.

In many states the maximum power limit is watts input. Operation of the DX-100 and king at this low input can lead to other probns such as arc-over and severe distortion due : extreme change in plate impedance as esented to the secondary of the modulation nsformer.

Some of the methods tried to reduce the input either of these transmitters to the 25 watt el include using a lightbulb or resistor in the mary of the plate transformer. This results in ite poor regulation which leads to other probns which will not be discussed here.

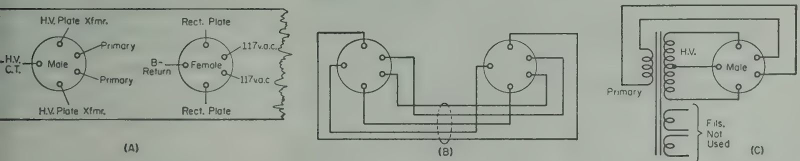
It occurred to the author that another method, s expensive than purchasing a variac type nsformer, was capable of giving the desired sults with only slight modification of the ginal transmitter. This modification should not duce the resalability of the transmitter.

In a few words, this system entails using a TV e power transformer which may easily be vaged from an old chassis. The two primary and the three secondary leads of the plate transformer in the transmitter are disconnected inside the transmitter and reconnected to the five-pin Amphenol MIP male chassis plug mounted on the rear of the chassis. A five pin female MIP plug is mounted near the male plug and then wired to the appropriate points in the transmitter from which the plate transformer leads were disconnected. A jumper cable is then made using five lengths of high-voltage plastic insulated wire, ending in a male plug at one end and a female at the other. Another five pin male plug is then used to connect to the primary and high-voltage leads of the TV power transformer. All these connections are shown in fig. 1.

For normal operation the jumper cable is used between the two chassis plugs thereby connecting the regular plate transformer into the circuit in the normal manner. For QRP operation the jumper cable is removed and the TV transformer plugged into the female plug.

Caution: make sure the insulation used for the jumper cable wiring is enough to handle the high voltage.

Incidentally, QRP operation is a good idea on other bands when the full power of the transmitter is not needed.



. 1—The modification shown above permits operation of the DX-100 or Viking transmitters at 25 watts on 0 meters. The male and female plug arrangement is shown in (A) while (B) shows the simple jumper plug used for normal operation. A TV type power transformer shown in (C) is used for reduced power.

HQ-100 Improved

You can improve c.w. performance by addg the b.f.o. kit, Hammarlund Part Number T-38657-G6. When this kit is installed, the *Q* multiplier is no longer thrown into oscillation and can therefore be used to peak up a signal.

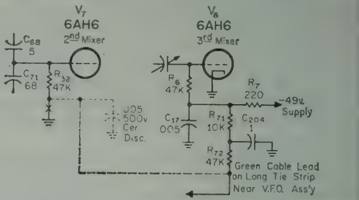
HQ-170 Frequency Stability

K8ZHZ modified his)-170 to improve frequency stability by wiring a separate 6.3 volt filament transformer (1 a.) feed the h.f. oscillator and mixer tubes. The be filaments are on continuously. He also inlled a coax connector for the 6 meter band tenna input. He tapped the coil 1 turn from e bottom for a better match for a beam antenna. This modification allows the 50 mc antenna to remain connected, and still provides a 2 meter converter connection. The original 6 meter coil connection to the antenna terminal strip is, of course, removed.

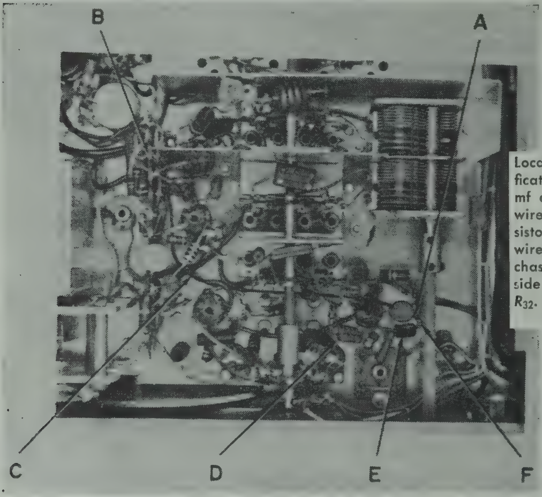
Incidentally, to further improve the HQ-170, replace the tube rectifier with silicons. This cuts down the internal heat.

HT-32 or 32A Modifications

Certain installations involving Models HT-32 or HT-32A, where a TR switch or two separate antennas are used, make it necessary to key or cut-off more than one mixer stage. This is necessary to attenuate the signal level sufficiently so that it will not be heard by sensitive receivers. To alleviate this condition, a modification is necessary to apply cut-off bias to the second mixer grid as well as to the third mixer grid during standby or when the key is up during c.w. transmission. With both mixers blocked, the signal level will fall well below the noise level encountered in even the most quiet receiver locations. This modification will not require any readjustment of the HT-32 or HT-32A circuits, nor will it change the operating procedure from that specified in the instruction manual. S fig. and the photo for the necessary modific tion information.



HT-32 and HT-32A keying modifications. Check photo and caption for details.



Location of parts in HT-32 and HT-32A mo fications. (A) by-pass at this point with .0 mf ceramic disc at 500 v. (B) connect ne wire to this terminal (Junction of 4.7K r sistor and green cable wire). (C) lay ne wire lead along this path, lay wire down chassis to avoid stray pickup. (D) clip grou side R_{32} (47K) resistor. (E) new position f R_{32}. (F) connect new wire lead at junction R_{32} (47K) resistor and disc by-pass.

HT-33A Linear Modifications

"Transformer hum" or 60 cycle mechanical vibration has been found due to the filter choke (L_3). Repositioning this slightly will eliminate the trouble. Fan noise is cured by installing a new fan blade and hub (Part No. 080-100583). Idling current instability is corrected by removing resistors R_{18} and R_{19}. R_{16} and R_{17} are r placed with 1000 ohm 2 watt resistors. A ne 100K 2 watt resistor is installed between th junction of R_{16} and R_{17} to the ground lug o the V_4 socket.

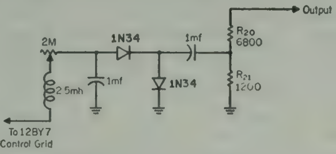
HT-37 Tuning Improvements

K2BGL says that he has ob- ained better carrier suppression in the HT-37 by sing his receiver S-meter. Receiver audio gain s OFF; R.F. GAIN control adjusted to give a half neter reading or S-9. When the HT-37 is placed on MOX position, AUDIO GAIN is reduced to zero and the balancing pots are adjusted for minimum carrier. Frank says he has obtained from 8 to 20 db suppression improvement by this method.

HT-37 Automatic Load Control

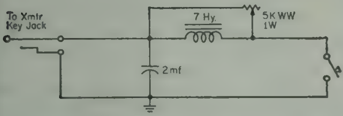
First remove the HT-37 rom its cabinet. Then remove the shield from he final tank. Construct the voltage doubler on terminal strip and attach it to the front of the hield. Connect the doubler between R_{20} and R_{21}. Then mount the pot through the available ole in the rear apron and connect the output of he doubler to one end of the pot. From the enter leg of the pot connect the 2.5 mh choke, he other end of this going to the driver stage ontrol grid, *i.e.*, pin #2 of the 12BY7. Replace he shield and the case.

To adjust the circuit, begin operation with aximum resistance of the pot all the way in. Load the transmitter normally, then set the pot to the level of output desired (any point below maximum). The transmitter will now peak to this level and will *not* flat-top.



Automatic load control circuit for the HT-37.

HX-10 Marauder Key-Click Filter



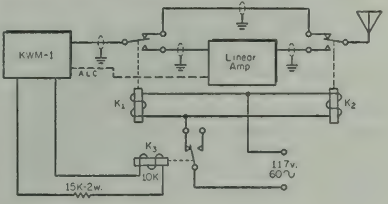
Key click filter for the Heath HX-10 Marauder Transmitter.

Bond all equipment together with short leads and avoid that ¼ multiple length. An inexpensive low pass filter may also clear up your trouble. The HT-41 is a good set—we receive very few requests for technical assistance on it, other than how to feed it with a set other than the HT-37 for which it was designed.

KWM Modifications

In early production KWM-1's, there is an unsed contact on relay K_1. This is normally grounded, and opens on transmit. Run a wire rom this terminal to feed-through condenser, C_{16S}. This then provides a terminal, #18 on P_5, o operate an external receiver. This point would onnect to terminal 2 on the 75A-4 standby strip. A ground connection will also be necessary. Late roduction KWM-1's have this wire already intalled.

To operate external relays for a linear amplifier, there are two methods: (A) For d.c. operation, run a wire from terminal 8 on TB_1 to an unused terminal on P_5. This provides a +260 volts in the transmit position. The relays should have at least 10,000 ohms resistance and have a



Circuit of d.c. relay hookup when using the WM-1 with a linear amplifier. Relays K_1 and K_2 are onventional 110 v.a.c. coaxial relays. Relay K_3 is any 0,000 ohm d.c. relay requiring 10 ma or less for pull-in.

15,000 ohm 2 watt resistor in series. See the 399B-1 DX adapter schematic for coil hookup. The total current drain should not be more than about 10 ma.

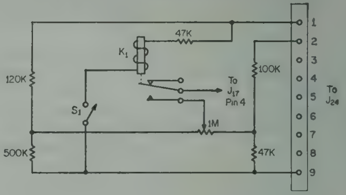
(B) If a.c. relays are to be used, there is 110 v.a.c. available in the transmit position by using terminal 8 on P_1 of the a.c. supply and terminal 2 on either T_1 or T_2. These relays should be low current a.c. relays to prevent switching transients from causing the vox to chatter. When using thi method, it is recommended that an interlock be provided to prevent the final amplifier from coming on with an open antenna circuit.

For a.l.c. operation of a linear, bring out a wire from pin 7 of V_{10}, 6AL5 rectifier to feed-through capacitor, C_{166}, which is terminal 17 on J_5.

Independent Receiver Control

The unit described below will permit independent tuning of the KWM-2 receiver over a range of about 2 kc, involves no modifications to the transceiver and costs only $4.60 if all the parts are purchased new. Connections to the KWM-2 are made by a nine pin plug inserted in the noise blanker power socket J_{24} and a single wire pushed into J_{17}, pin 5.

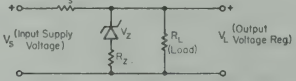
The 70K-2 p.t.o. used in the KWM-2 and S-Line equipment contains a diode switch, CR_{301}, which in conjunction with C_{308} shifts the p.t.o. frequency about 2.5 kc when changing sidebands. The switching action is obtained by applying either a 200 volt forward bias or 32 volt reverse bias to CR_{301}. If the diode bias is made variable, the p.t.o. may be tuned incrementaly across the 2.5 kc range. The addition of a relay applies this variable bias during receive condition only so that on transmit the p.t.o. will return to the dial frequency. Since the relay is controlled by B plus, no changes are needed when going from fixed to mobile operation. The s.p.s.t. switch S_1, disables the variable bias and returns the p.t.o. to normal transceive operation. The unit may be mounted anywhere, but one of the best methods is to put all of the components in a small mini-box and mounted it on the side of the KWM-2 using existing holes.



Simple circuit used to enable tuning the KWM-2 receiver over a 2 kc range. On transmit, the frequency reverts back to the dial setting. The 1 meg pot is a Mallory UA16L and SL3500 shaft with a Mallory US41 switch. The relay, K_1, is a Sigma 11F-2300G/S1L or equivalent.

KWM-2 on AM

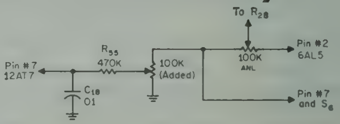
Inside the KWM-2 on the front right side on top the chassis you will find *two* controls which are marked, "carrier balance." One of these controls is a potentiometer (screwdriver adjustable), this is your "a.m. control." The other is a round variable ceramic capacitor—*leave this one alone.* Tune up the set as you generally do and set it back to u.s.b. Use the push-to-talk for operation. Place the mete switch in the plate position then rotate the carrier balance pot for maximum plate current You'll find that you have about 85 to 90 ma Then adjust your mike gain for a small flicke on voice peaks. Do not ride the mike gain—kee it down! You'll be running about 12 to 15 watt of power, plenty for a.m. local rag-chews. T go back to s.s.b., adjust the carrier pot to it original position (which you should mark). Fo *best* carrier null, use another receiver and watch its S meter as you turn the pot shaft with the rig in the u.s.b. position and PTT keyed on. Se the pot for minimum S meter reading.



Regulator circuit with zener diode.

Decreased S-Meter Sensitivity

To decrease sensitivity of the S-meter by a fixed amount, decrease the value of R_{30} (68K ½ watt). To decrease or increase the sensitivity of the S-meter by a variable amount, replace R_{43} (33 K ½ watt) and R_{30} (68 K ½ watt) with a 100k potentiometer. Connect the arm of the pot to R_{55} (470K ½ watt).



NCX-3 Modifications

Some mikes used with the NCX-3, especially hose using 'coil cord' have a tendency to introluce r.f. feedback into the NCX-3 through the nike pre-amplifier. The r.f. feedback usually hows up after you have had the NCX-3 fully oaded and start to increase the mike gain control. uddenly the plate current will jump up to 300 nils *without* audio input and sometimes the osillation can be heard on the signal. This feedback nay also manifest itself by the "breaking up" of he transmitted audio when the mike gain is dvanced beyond a certain point. We have found hat simple by-passing will eliminate this r.f. eedback. The following is suggested: add a 003 mf/500 volt d.c. capacitor from the hot ide of the mike jack to ground. Add a .001 nf/500 volt capacitor from pin #2 of V_{7A}, vhich is ½ of the 6GH8 to ground. If your ICX-3 uses the 6AN8 in place of the 6GH8, ne correct pin connection for the 6AN8 is pin #8.

If the r.f. feedback persists, add an additional 001 mf/500 volt capacitor from pin #2 of the V_{6B}, which is ½ of the 12AT7 speech amplifier ground. The leads for all capacitors should e as short as possible.

This item is relative to vox adjustment. Some ICX-3 owners set the VOX SENSITIVITY much too igh. This results in lack of anti-vox action and here is interaction between the VOX SENSITIVITY nd the VOX DELAY controls. The interaction will ause erratic VOX DELAY operation. Set the VOX ENSITIVITY control so that it *just* trips the VOX ircuit when the mike is close talked, and VOX ELAY control is set for minimum delay. In vox perations, the mike should not be farther than vo inches from your lips for normal speech onditions. One-tenth of a second should be ne elapsed time between transmitter and reeiver action. Then adjust the VOX DELAY control ockwise for proper delay to suit you. Check ne vox diodes, D_4, D_5 and D_6 if you continue experience difficulty. The back resistance of nese should be two megohms when one end is emoved from the circuit. National will replace ny defective ones at no charge.

Erratic operation in the vox mode may be aused by a small a.c. voltage (hum) being fed ito the NCX-3 when insufficiently shielded ikes are used. This erratic operation shows up in the form of chattering or hanging-up of the relay and can be prevented by making the simple change as follows: there is a yellow wire which runs from the VOX-PTT switch to the rear apron of your NCX-3 to the mode switch on the front panel. If this yellow lead is replaced with a *shielded* lead, with the shield grounded, this condition is eliminated and normal vox operation can be obtained.

Occasional complaints of vox hang-up can usually be traced to unusually high negative bias voltage from the power supply. The recommended bias voltage is 80 volts. Higher bias voltage may be due to unusually high line voltage. If the high line voltage persists try some resistance in series with the bias line.

The NCX-D d.c. power supply is designed and guaranteed for a nominal input voltage of 12.6 volts with maximum voltage excursions from 11.5 to 14.0 volts. Input voltage higher than 14 volts will permanently damage the power transistors. Check your generator system voltage! Before installing an NCX-D adjust the voltage at maximum (and/or idling) speeds for *no* more than 13.5 volts.

Mobile noise seems to be a problem with a number of hams, but a little patience and knowhow can eliminate most of it. Using resistor-type sparkplugs will help immensely. Using coaxial condensers in series with wires *feeding* the high tension coil, ignition switch etc., will help tremendously. Generator whine on 20 meters can be reduced or eliminated with a tuned trap in the generator output lead.

If you want additional vox delay change C_{118} from .1 mf to .25 mf.

"Transmit-receive clicks" heard on some NCX-3s, caused by switching transients, can be reduced as follows: on the TRANSMIT RECEIVE RELAY, there is an additional contact marked pin #19. If a lead is run from this contact to pin #5 of the Jones power plug, which is on the rear apron of the NCX-3, and then very carefully dressed along the inside edge of the underside of the chassis, it will provide you with a ground for the speaker leads. This lead should follow the cable harness that runs to the relay as closely as possible, and should be kept very close to the harness. If care is not taken, carrier leakage could develop.

NCX-3 CW Monitor

As you can see in fig. 1, plug P_2 is connected the transceiver keying jack and is connected ght to the key through J_1. But the outer conuctor of J_1, instead of going back to ground, oes to the base of transistor Q_1. With the key up, there's no base current through Q_1, and the transistor is off. With the key down, the keying current from the transceiver biases Q_1 into saturation.

Meanwhile, transistors Q_2 and Q_3 form a

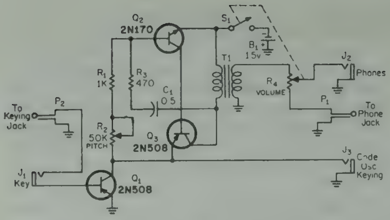


Fig. 1—Circuit of a c.w. monitor suitable for use with grid block keyed transceivers. Be certain to insulate J_1 from the chassis. Transformer T_1 is a subminiature unit such as Argonne AR-136 or equivalent.

simple oscillator. The complimentary-symmetry circuit uses two transistors in a phase-shift oscillator circuit, where the feedback from the collector of Q_3, through C_1 and R_3, to the base of Q_2 causes oscillation. The frequency of the oscillator is adjusted by control R_2 (PITCH). If you examine the circuit carefully, you will see that the supply voltage from battery B_1 has to go through transistor Q_1 to feed the oscillator. If we saturate transistor Q_1 (or key the unit with a key plugged into the optional code practice oscillator keying jack), the oscillator starts.

Transformer T_1 couples the output from the oscillator into the earphone circuit, through volume control R_4. By connecting the phone output of the transceiver to the other end of R_4, the volume control really becomes a mixer which mixes the received signal with the monitored signal into the same pair of phones. Once you correctly set the PITCH and VOLUME controls, and adjust the receiver audio gain, no further adjustments are required.

If you wish to connect a speaker instead of phones, the oscillator has enough output to drive one. Just connect a 4 or 8 ohm speaker instead of the 100 ohm primary winding of the transformer (T_1).

Construction

The unit was built in a readily available aluminum box measuring about 1½ by 2 by 4 inches, but it's a tight squeeze. A somewhat larger box is preferable, especially if you want to add a miniature speaker.

To begin, drill the two holes for the jacks, making the opening for keying jack J_1 a little larger than the diameter of the jack bushing. Using two insulators and a little tape, mount the jack in the hole, making sure that the frame of the jack is insulated from the case. Also drill two openings for the two cables to the transceiver. Though we used shielded cable because it's handy, any other type of two conductor wire is good.

Now drill two openings for the VOLUME and PITCH controls. We used miniature controls designed for transistor circuits, with tiny clock radio knobs friction-fitted to the shafts. Two parallel terminal strips and a battery holder, mounted inside on the bottom, and the transformer, squeezed into one corner, complete the mounting of parts. The small parts, such as transistors and resistors, are mounted point-to-point between terminals on the terminal strips. Keep all wiring short and direct; there are no critical part placements or wiring lengths to worry about, but a neatly laid out unit always seems to work and look just a little better.

Using The Monitor

Plug the key and phones into the monitor, and plug the monitor phone and key plugs into the transceiver. Set up your transceiver for c.w operation, turn on the monitor, and depress the key. Adjust the volume and tone controls on the monitor for a pleasant tone. When you go back to receive, readjust the audio gain control on the transceiver for a comfortable listening level since there's a little interaction between the audio gain control and the volume control That's all there is to it.

Once the monitor is connected, it need never be disconnected. If you go to phone, just turn off the monitor. If you were careful to wire the monitor volume control so that the arrow on the schematic is in the direction of clockwise rotation, then turning the volume control off (until the switch clicks) just connects the phones directly to the phone output of the transceiver. To prolong the life of the battery, just make sure to turn off the unit when you're QRT.

SB-10 on 6 Meters

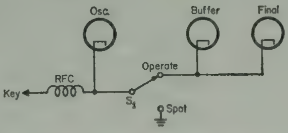
A number of hams have used the 10 meter position in the SB-10 for 6 meter operation by trimming coils and r.f. phase-shift network adjustment (using smaller capacitance values). They then fed the SB-10 a 50 mc signal directly from a stable source.

Changing the r.f. phase-shift network *is* a job for 50 mc operation! As a starter, try substituting 55 mmf for the 110 mmf capacitors now used in the 10 meter position. If you still have trouble, then give some attention to the r.f. chokes used. A switch to v.h.f. chokes in the 10 meter position will help.

Another way would be to use the heterodyne converter described in the June 1963 issue of *CQ* by W9BUB. If you already have a good stable 64 mc signal source, you need use only the last stage of W9BUB's circuit, the 6JH8. However, nember that the SB-10 *was not* designed to hit 5 mc, the top injection frequency needed with converter. You'll have to do a little coil pruning of the 20 meter coils in the SB-10 to reach 14.5 mc. W9BUB's scheme will work FB with the SB-10.

T-60 Spotting

In one sition the keying is normal, in the other, it rmits operating the oscillator only for spotting, libration or zeroing in on a frequency without -the-air QRM.



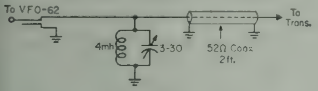
The spotting switch for the T-60 and similar transmitters is installed between the oscillator and buffer cathodes. S1 is a d.p.s.t. switch.

TX-1 VFO Improvement

Try a 6AH6 instead of the 6AU6. Because of the reased current required by the 6AH6 it is wise if a nsformer having the correct current and voltage output be used. The 6AH6 requires 6.3 volts at 450 mils, whereas the 6AU6 requires only 300 mils.

VFO-62 Increased Output

Connect a 4 μh choke or coil h a 3 to 30 mmf capacitor across it as wn. This coil-condenser combination may either at the phone plug end of the cable at the transmitter. The length of the coaxial le *is* critical since it becomes a part of the tuned circuit. Usually two feet of cable is sufficient and should not be exceeded. If longer lengths of cable must be used, the coil-condenser combination must be reduced accordingly.



Method of increasing voltage output from he National VFO-62, six and two meter v.f.o.

Tune the 30 mmf trimmer so that it resonates approximately in the center of the band or around 8.666 mc for 6 meters and around 8.111 mc for two meters. Under these conditions, the phone plug should be inserted in the PHONE jack on the back of the VFO-62 and connections should not be taken from the cathode follower output jack.

VFO-62 Stability

To reduce frequency shift of the VFO- when using remote switching, remove the nge wire from pin #1 of the 6BH8 tube ket which goes to the function switch. Then oute the orange wire around and to the out- e of the 0B2 v.r. tube socket and solder to the cinch lug containing junction of R_4 and L_5. This breaks up the large closed loop around the coils which have a tendency to shift the frequency of the unit when using function switch versus remote switching.

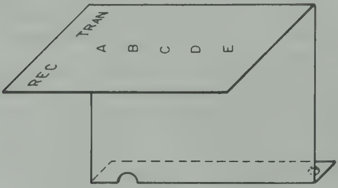
Convert Johnson 5 Channel CB Unit to 10 Channels

ne of the most popular if not the most oular transceivers up to a couple of years is the Johnson Messenger 5 channel. Even ay, the basic circuitry of the unit has been incorporated into Johnson's Messenger Two with two notable exceptions: the Messenger Two is a 10 channel unit with 23 channel tunable receiver and it has two additional I.F.

amplifiers. In less than 3 hours I converted the 5 channels of my Messenger into a 10 channel unit for $8.00—less crystals of course!

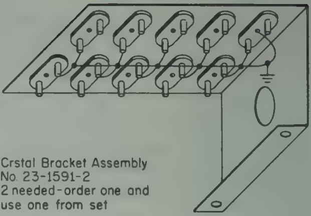
The parts needed are listed as follows and can be ordered through your local dealer or directly from the E. F. Johnson Co. of Waseca, Minn. One each of the following is needed; crystal hold down assembly, cat. no. 23-1384-1; crystal bracket assembly, cat. no. 23-1591-2; switch, cat. no. 22-1922-1; and if you want some method of indicating the 10 channels, Johnson makes a plastic piece called a channel indicator, cat. no. 23-1594-1. In addition to the above, two 470 ohm ½ watt resistors will be needed. Order these parts at least two weeks before you plan to make the conversion, for it was my experience that it took that long to receive the parts.

After removing the cabinet from the set, proceed to disconnect the original switch and crystal bracket assembly. Three wires will be found going to the original unit—a yellow wire which goes to the transmit crystals, a white wire which goes to the receive crystals, and a black wire which is grounded. When removing these wires, try to keep them as close to their original lengths as possible. The 1964 ARRL handbook gives some leeway when they say on page 143 ". . . frequency depends almost entirely on the dimensions of the crystals . . . the other circuit values have comparatively negligible effect." Either unsolder these wires from their terminals on the switch or else snip them with pliers as close to their switch terminals as possible.

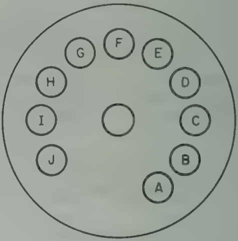


Crystal Hold Down Assembly
No. 23-1384-1
2 needed-order one and use one from set

Remove the crystals hold down assembly if you haven't already done so and proceed to remove the two bolts holding the crystals bracket assembly to the chassis. Remove the channel selector knob from the front panel and remove the switch and crystal assembly from the set. Before going further, enlarge slightly the hole in the front panel, as the shaft of the new switch is slightly larger than the old one.



Crstal Bracket Assembly
No. 23-1591-2
2 needed-order one and use one from set

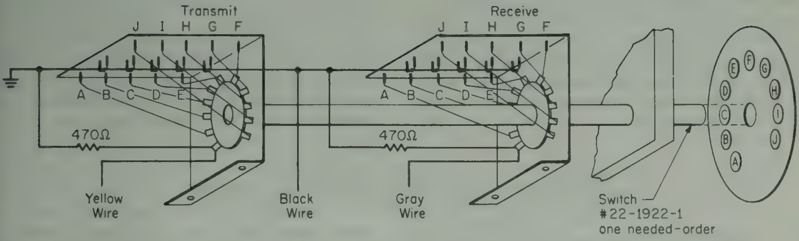


Channel Indicator
No. 23-1594-1
optional-order

Unsolder the wires which run from the crystal sockets to the switch. There will be 10
wires in all, and unsolder them where the
connect at the switch. Also disconnect the 68
ohm resistor and discard both switch and re
sistor for only the bracket assembly will b
used from the original equipment.

Loosely assemble the double gang switc
with the two crystal bracket assemblies an
check their alignment with the hole in th
front of the panel. The hole in the new bracke
will have to be lowered, as it is too high fo
the original hole in the panel to be utilized.

After all mounting holes have been properl
lined up, connect the inner or center tw
rows of the new crystal socket terminals wit
a common wire as was done on the origina
bracket assembly at the factory. Hook up th
wires from the outside two rows of socke
terminals on the original bracket assembly t
the terminals on the new switch. Do the sam
with the new bracket assembly after measur
ing the new wires to be as close to the length
of their counterparts on the original bracke
assembly as possible. Be sure that socket "A
in the original unit will be on when socke
"A" in the new bracket assembly is on, an
so forth. Take one of the 470 ohm resistor
and connect it from the pole terminal of on
switch, and ground the other end, and follow



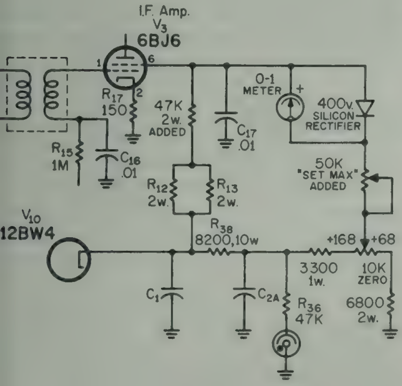
suit with the other resistor on the other switch. Connect the yellow wire to the rear bracket assemblies pole terminal and the white wire to the front bracket's pole terminal. With a length of wire connect the grounded terminals on one bracket assembly with those of the other bracket assembly, and then connect the black wire to some point of this grounding.

Bolt down the brackets in their respective positions. Use the original holes for original bracket assembly, and holes are already provided for the new bracket assembly. Two holes will have to be drilled for the new crystal hold down assembly. Place the receive crystals in the forward bracket assembly, and the transmit crystals in the corresponding sockets in the rear assembly. Fasten the crystal hold down assemblies over the crystals.

Finally, if you ordered the channel indicator plate, take it and remove the metal piece from the plastic. With a grinding wheel grind down a small portion of the plastic so that it will fit over the switch shaft on the outside of the panel, since it will not fit inside the set. Glue this piece in place, turn on your set, and you're on the air!

Add an S-Meter

The schematic hereabouts shows exactly how to put one of these meters—or any other 0-1 MA meter—into a Messenger 1. The same principle will work on any other set, too, just so long as the IF amplifier is AVC-controlled. You can tell whether it is or not by first finding the grid pin of the tube socket, tracing back to the IF transformer connected to it, and then tracing out the other wires connected to this same IF transformer. One of them will go to the plate pin of the earlier stage, one to B+, and the third will go either to ground, or to a resistor and capacitor combination, in which the resistor leads back to the detector stage. If you find this combination, the IF stage is AVC-controlled and the S-meter circuit will work nicely.



If your set's IF tube gets its screen voltage through a large-value resistor from the plate supply (many do) then you won't need to add the 47K resistor shown in the schematic here. Both of the adjustable controls should be placed either inside the set, or on the back panel. Once you set them up initially, you won't be touching them again until you change tubes.

To set up the meter, adjust the "SET MAX" control to maximum resistance, and adjust the "ZERO" control until the meter reads exactly zero with the rig well warmed up. To check the accuracy of the zero setting, reduce the "SET MAX" control. Re-zero if necessary; the needle should stay firmly on zero regardless of the "SET

MAX" setting, with no antenna connected. Next, tune in a strong signal, which you consider to be about S9 (if you have access to a signal generator, feed in 50 microvolts of signal) and adjust the meter to read S9, with the "SET MAX" control. Then secure both control shafts firmly with a drop of glue or Glyptal varnish, and you're in business.

The diode across the meter, incidentally, is to protect the meter movement. In the Messenger 1, the screen voltage of V3 swings from 80 on receive up to 210 on transmit, and the meter will run right up against the right-hand pin when you push the button to talk. The diode protects the meter from burning out, when this happens. It might not be needed on other rigs.

Receiver Drift Cure

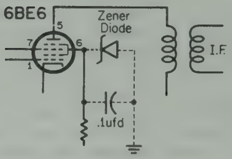


Fig. 1. Receiver drift cure for tunable units. Added circuit is shown in dotted lines.

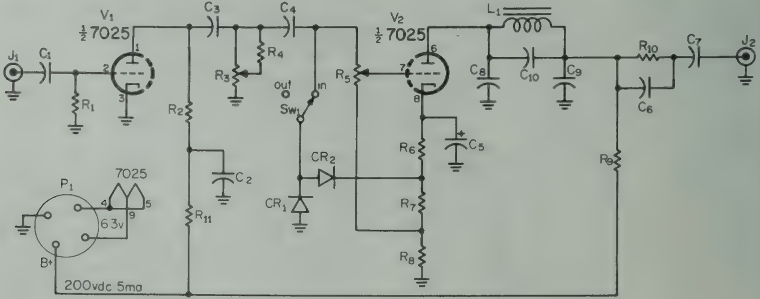
Determine the screen voltage of the receiver's oscillator tube and then obtain a Zener diode with a cutoff voltage of approximately 10% less. For example, if the screen voltage is 73 volts, 10% of this would be 7.3 volts, and you would want a 65 to 67 volt Zener. Using short leads and a heat sink, solder the Zener from the screen pin on the tube socket to ground. Place a .1 ufd disc capacitor in parallel with the Zener diode. This whole circuit, as it would be hooked up in a typical receiver circuit, is shown in Fig. 1.

CB Preamp/Speech Clipper

It's a 1 tube job which offers preamplification with the plus of speech clipping

PARTS LIST

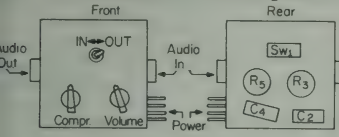
C_1	.02 ufd
C_2	10 ufd 250 VDC electrolytic
C_3	.003 ufd
C_4	.01 ufd
C_5	20 ufd
C_6	300 uufd
C_7	.05 ufd
$C_{8,9}$	200 uufd
C_{10}	180 uufd
R_1	2.2 meg
R_2	220K
R_3	500K potentiometer
R_4	100K
R_5	100K potentiometer
R_6	300 ohms
$R_{7,8}$	600 ohms
R_9	220K
R_{10}	200K
R_{11}	47K
L_1	4.5 Hy filter choke
$CR_{1,2}$	1N34 crystal diodes
$J_{1,2}$	Standard mike connectors
P_1	4 prong connector
SW_1	SPST toggle switch
V_1	7025 tube
Misc. hardware, knobs, Mini-Box, tube socket, etc.	



r that extra "punch," or, as so many CB'ers ll it, "talk power."

Without resorting to a difficult-to-under- and technical tirade, you will be interested learn that by utilizing a clipping device at can be adjusted to clip peaks in the eech wave at any desired amplitude, power the speech wave can be increased to equal e same peak amplitude. This is true be- use the low level portions of the wave can further amplified without causing over- odulation on signal peaks. These peaks are ld at a constant amplitude by the clipper, d amplification prior to the clipper in- eases the speech power without increasing e peak amplitude.

Once the modulator gain has been set for 0% modulation it will be impossible for ou to overmodulate because the clipper will eep the maximum output at a constant level gardless of the amplitude of the signal ap- lied to it. This is an added advantage of eech clipping.



GENERAL DESCRIPTION

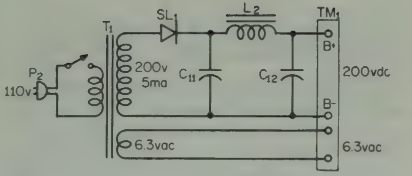
The unit described here is an effective eech clipper, preamplifier. It contains its wn splatter filter and can be used ahead of ny CB rig having a high input impedance. provides variable level speech clipping and eamplification.

The power required for the unit is small, ly 200 VDC at 5 ma. and 6.3 VAC at 300 a. A simple and inexpensive means of ob- ining the above voltages is by taking it rectly. from the CB rig. However at this 0-20 a small power pack using a selenium ctifier supplies the power for the unit.

CONSTRUCTION

The YANKEE CLIPPER can be built into st about any type of Mini-Box. The unit ilt here is housed in a 5" x 4" x 3" *Mini-Box.* he operating controls are mounted on the ont panel with the power and audio con- ections on the sides.

The YANKEE CLIPPER centers around n inexpensive type 7025 tube, available for out $1.35. The tube socket is mounted on n angle bracket. The splatter filter (L_1, C_8, C_9, and C_{10}) is mounted on the upper right, as shown in the parts layout (rear view).



PARTS LIST

$C_{11, 12}$	**Dual 16 ufd electrolytic 250 VDC**
L_2	**4.5 Hy 30 ma. filter choke**
T_1	**Power transformer. 6.3 VAC & 200 VDC @ 5 ma**
P_2	**110 VAC plug, chassis mount type**
TM_1	**4 screw terminal strip**
SL_1	**Selenium rectifier, 5 ma**

Filament leads are twisted and kept clear of low level grid leads. Both grid circuit leads are shielded.

Reasonable care should be exercised in locating components to keep as much separation between stages as possible.

The power supply was also housed in a 5" x 4" x 3" *Mini-Box*. No special precautions are necessary in its construction. By the way, this power supply is a handy thing to have around a shack since it will power many accessories available to CB, in addition to many of the projects in S9.

OPERATION & ADJUSTMENT

The adjustment of this unit requires an oscilloscope or some other reliable modulation indicator. Procedures for adjusting and analyzing patterns will not be discussed here as information is readily available on the subject.

Adjust the limiter control (R_3) for maximum clipping and talk into the mike at normal intensity. Adjust gain control (R_5) in conjunction with the gain control of the transmitter (if there is one) for 100% modulation. Once this adjustment has been made, the gain controls should not be moved. The limiter control can now be varied for any desired amount of clipping without overmodulation.

The desired amount of clipping varies under different receiving conditions and can best be adjusted by receiving different on-the-air checks. As a general rule, heavy clipping should be used only under adverse conditions, while moderate clipping can be used at all times.

Untuned IF Stage For 8-10 DB Gain

This almost sounds too good to be true, but this gadget *will* work in any CB rig, giving you a cool 8 to 10 db gain on incoming signals.

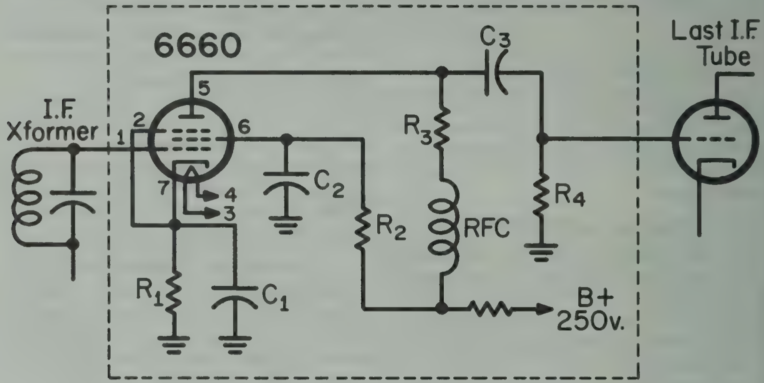
The unit is inserted in the circuit of the receiver at the points marked "X" which break the lead from the IF transformer to the signal grid. This will effectively place the two IF tubes in cascade.

After the circuit is wired into the receiver, the IF input transformer will require realignment. This is the only adjustment necessary.

The B+ voltage is 250 volts; with 6 volts on the filaments. The 6660 tube is available from most radio supply houses for about $1. Other tubes which will work in this circuit are 6BA6, 6CG6, 7543, 6AU6, 6BD6, and 6136.

PARTS LIST

$C_{1,2,3}$	**.002 uf 400 WVDC capacitors**
R_1	**68 ohm resistor**
R_2	**47K ohm resistor**
R_3	**2.5K ohm resistor**
R_4	**100K ohm resistor**
R_5	**1K ohm resistor**
RFC	**50 uh choke**
6660	**type tube and socket**



Variable Tuning for Fixed Tuned CB

Is your transceiver one of the models which features crystal receiving only, with no provision for tuning all the way across the band to see what's happening in a hurry?

If it is, here's a gadget you may be interested in. You can put it together in a single evening, and when you're done you'll be able to tune across all 23 channels (with a little extra at each end). Best of all, it requires no tubes or transistors and merely plugs into your set like a crystal. Some sets, however, require one additional connection under the chassis for best results.

To build the *Vari-tuner* the first thing you need to do is collect all the parts. You'll need a 15-mmf variable capacitor, of the best quality you can find. A Hammarlund HF-15X is excellent. In addition, you'll need two 82-mmf silver-mica fixed capacitors, and one 51-mmf unit (also silver mica). A 0.47-microhenry variable inductor (J. W. Miller Part No. 40A-77CBI is recommended), a dial such as the National MCN, and a case to hold it all complete the parts list.

Drill the case to hold the dial, following the template furnished with the dial you purchase, and make a mounting bracket from heavy (at least ⅟₁₆-inch) aluminum strap to hold the capacitor in place behind the dial. Mount the variable capacitor on the bracket, and drill a holl for the coil form in the back of the case. Also drill a ⅜ inch hole for the output coax ear the coil-form hole, but be sure to leave nough clearance that the coax can't rub gainst the coil.

Wire the variable capacitor in parallel with he coil, using wire of at least No. 16 size for he leads. Everything inside the box must be tiff and unable to vibrate if you don't want o have "vibrating signals" after everything is omplete. Wire one of the 82-mmf and the 51- mf silver micas in series and connect them cross the coil also. Then wire the other 82- mf silver mica from the stator of the variable apacitor to the end of the connecting coax (a ingle-point tie strip comes in handy here but not absolutely necessary if you cut the apacitor leads short. The frame and rotor of he capacitor connect to the shield of the coax, hich also grounds to the metal case.

At the other end of the coax, connect the hield braid to the grounded side of a receiv- g-crystal socket and the center conductor to he "hot" side of the crystal socket. This com- letes installation for most sets.

To check out and adjust the *Vari-tuner* you'll eed either a signal generator or a grid-dip eter to give you a source of variable-fre- uency signals in the 11-meter band. Start by rning everything on and sweeping the signal enerator frequency across the band to find ut what part of the spectrum you're receiving.

If you don't get any response, your trans- eiver may be of the type that requires an un- er-chassis connection. Trace out the crystal- scillator wiring in the receiver portion; if an F choke is between the oscillator cathode nd ground, you need a second length of coax the vari-tuner. The shield of this coax is also rounded; the center conductor ties the oscil- tor-tube cathode to the junction of the 82- nd 51-mmf capacitors in the vari-tuner. Wiring side the transceiver is not disturbed by this onnection; the coax simply connects to the cathode in addition to any other wires already there.

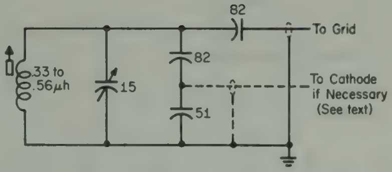


Figure 1. Schematic diagram of vari-tuner. All leads should be as short as possible, and all parts must be mechanically solid so that they can't vibrate. Otherwise construction is not critical.

When you get a response, check the frequency to which the signal generator is set. If it's near the 11-meter band, you're ready to go. If, on the other hand, it's in or near the 10-meter ham band, tune the signal generator low and find another response near 11 meters. This is the one to use.

Now set the signal generator to the frequency of Channel 1 (better yet, use an extra transmitter with a Channel 1 crystal in it) and set the vari-tuner capacitor so that it is about 10 per cent short of being fully meshed. Adjust the tuning slug of the coil on the back of the vari-tuner until you get peak response from the Channel 1 signal.

To check, move to Channel 23 and tune for it with the vari-tuner. You should find the Channel 23 signal somewhere between the 10-per-cent-meshed and 40-per-cent-meshed positions of the capacitor.

If you like, and have access to enough crystals, you can mark the dial directly in channel numbers. Alternatively, you can prepare a chart showing the dial reading for each channel.

The vari-tuner should work with any tube-type transceiver. It's not recommended for transistorized gear.

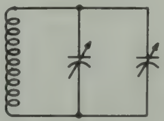
mproving Gonset CB Variable Tuning

Judging by the number of Gonset G-15 CB ansceivers we have seen with reworked receiver nable oscillator circuitry, this feature seems to giving users and technicians alike a hard time nerally.

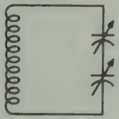
Such a device is difficult to engineer in the first ace because the relatively high frequency of mc makes it prone to instability due to heat, midity and vibration, and because of the nar- w channel separation the dial markings can be ly approximate at best.

The type of bandspread used in the G-15 arallel) seems to give rise to the most common mplaint—the channels being squeezed together d not covering the entire dial.

Parallel bandspread works fine on the BC band where every technician knows how to track a receiver by adjusting the inductance at the low end and the capacity at the high end. However at CB frequencies the values of C and L are decreased by a factor of about 50 and adjustment becomes correspondingly more difficult or, practically speaking, impossible.

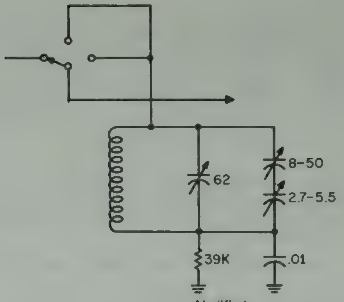


Parallel Bandspread



Series Bandspread

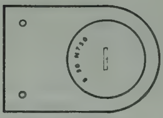
But there appears to be a better way—series



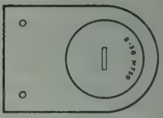
as Modified

bandspread. In this scheme a trimmer capacitor and a variable capacitor are placed in series across the terminals of the oscillator coil. With the trimmer at minimum capacity bandspread will be at a maximum and the dial may cover only a few channels. Conversely, with the trimmer at maximum, all of the channels will be squeezed into only a portion of dial rotation. While the proper amount of spread is being achieved by adjusting the trimmer, the band is kept centered on the dial by small variations of the oscillator coil tuning slug.

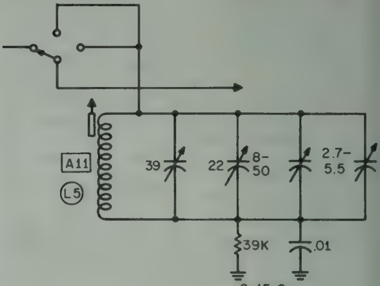
As received from the factory, the G-15 oscillator coil has four capacitors across its terminals—one each 39 mmf and 22 mmf fixed, and 8-50 N750 ceramic trimmer and the 2 plate variable tuning capacitor. If this original setup has been altered, the two fixed units can be replaced by a single 62 mmf silver mica or other zero drift capacitor.



Trimmer Set at Min.



Trimmer Set at Max.



G-15 Osc.

The 8-50 mmf trimmer, however, should be a exact duplicate if it is missing, and this is the on which is used as the series adjustable trimme

It may be mounted as shown in the diagra by soldering one terminal to the variable tunin capacitor and the other to the heavy bus wir which is previously unsoldered at this point an bent about one half inch toward the rear of th set.

It will probably be necessary to touch up th oscillator tuning slug very slightly after returnin the set to the cabinet, through the hole provide in the bottom for that purpose.

TEST GEAR
& MISC.

Transmitting Tube Protector

OFTEN in amateur transmitters, blowers are incorporated to prevent final tubes from overheating. In some cases, loss of the forced column of air from the blower will result in complete destruction of the final tube (4X150's etc.). A very simple and inexpensive way to protect these tubes is to install a thermistor in the air stream near the tube. When wired in the circuit of fig. 1, the relay will close ringing the bell, lighting a light, shutting off the rig, or whatever you desire, as soon as the temperature exceeds the predetermined value. R_1 is the calibrating resistor.

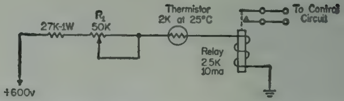
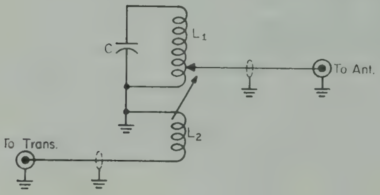


Fig. 1—Schematic diagram of the air stream thermistor installation near the final amplifier tube. The thermistor can then control a relay which could light a warning lamp, or simply shut off the rig. Excessive heat near the final can destroy the tube.

The values of resistors used will vary with the relay and thermistor used. The ones given in the schematic should be used only as a guide. As the temperature increases, the resistance of the thermistor will drop and the current through the relay increase. At the preset temperature, enough current will flow through the relay to close it.

Although this idea is not new, availability of the thermistor in recent months prompted this application. Many medium powered VHF transmitters, such as the popular 829B's, the new crop of s.s.b. heterodyne units and the 50 and 144 mc hundred-watt-plus amplifiers are ideally suitable.

Antenna Tuner

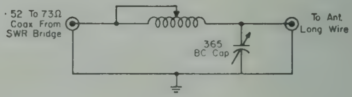


A simple antenna tuner that will work on all bands. C—is about 4 mmf per meter (example 40 meters —150 mmf). L_1—Should resonate at ½ mesh of the condenser at desired band. The coupling between L_1 and L_2 can be made variable for added convenience.

The unit can be built using either ready wound coils or B&W or Air Dux coil stock. The ready wound stock can be bought from any local radio supply house or from the mail order catalogs. If you operate one band only the construction is simplified. If you buy ready made coils buy the coil for a band higher than the one used and select a condenser of about 4 times the band used, in other words get a twenty meter coil and a condenser of about 150 mmf for operation on 40 meters. Loading can be increased by moving the antenna tap toward the ground. The voltage rating should be at least four times the peak voltage for a good safety factor. The tuner will work with a single end fed long wire or any coax fed antenna. Always use a good ground.

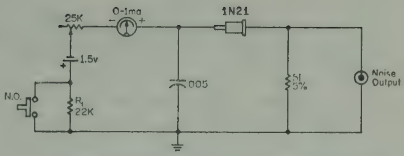
Another Antenna Tuner

An antenna tuner for loading longwire antennas. The coil is 30 turns of Airdux #1010 or equivalent with every other turn depressed for ease in clipping the adjustable tap. A multicontact switch could be used for a switchable adjustment.



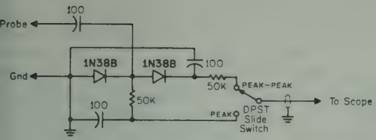
VHF Noise Generator

Normally the noise generator is used in this manner: voltmeter is connected to measure the noise content generated by the receiver. Then the noise generator is turned on and adjusted to just double this figure. The lowest meter indication which doubles the noise correspondence to the lowest noise figure. The exact noise figure cannot be measured or calculated unless you have an elaborate tube generator which indicates filament temperature. I use the generator shown in the photographs in a somewhat different manner but find the results are every bit as good as the above system. Further it is not necessary to disassemble the receiver o connect a meter. Connect the noise generator to the onverter through a short length of coax. Turn the otentiometer all the way to the left for the lowest ieter reading. Slowly advance the knob while alterately pressing and releasing the pushbutton switch. t the first point where you can *just* hear the noise icrease note the reading of the meter. Then readjust ie converter input coil and try it again. When the onverter is properly adjusted you will be able to ear a perceptible increase in noise with a meter readig as low as 200 microamperes (0.2 ma). The lower ie meter reading, the better the converter noise figure. ny 0-1 ma meter may be used as long as the divisions re large enough to read. If you have an accurate oise generator available, conceivably it is possible to alibrate the meter to indicate noise figure directly.



A simple noise generator for accurate peaking of v.h.f. receiving gear. Resistor R_1 should be disconnected if the generator is to be idle for long periods to prevent unnecessary battery drain.

Peak & Peak-to-Peak Probe



Circuit of a simple peak and peak-to-peak demodulator scope probe.

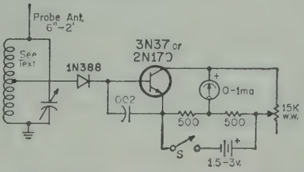
This probe is simple to make and can be contained in the body of an old ball point or marking pen. Coax cable is used, of course, for connection to the scope. The probe point can be the pen point (if the pen body is not metal). When the switch is in the peak position, you will note that one diode is used, in the peak-to-peak position both diodes are used. It is a good idea to use matched diodes, *i.e.*, both having the same back and forward resistance.

1 Transistor FSM

The field-strength meter (FSM) hown is a good one and requires only one tranistor. It should be built in a metal case. It can e used for adjusting beam antennas, transmitter une-up and as a monitor by connecting a pair of hones in series with the collector and the meter. f you use plug-in coils, make certain that one is lugged in before turning the unit on or your ieter may be damaged.

No tuned circuit values are given on the diaram. One need only to employ the coil available vith the correct variable capacitor. However, or those who desire to cover 10, 15 and 20 ieters, try 6 turns of No. 22 enameled wire on one inch form spaced so that the coil covers ist a little over a quarter of an inch on the orm. Tap the coil at 1½ or 2 turns. Use a 100 mmf variable capacitor.

The antenna probe can be from 6 inches to two feet long depending on the sensitivity required—the latter length being used perhaps for checking out a beam antenna some distance away from the antenna location.

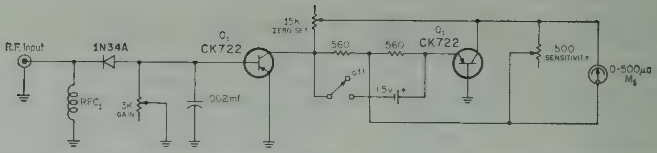


A field strength meter. Any good NPN transistor will work fine.

High Gain FSM

THIS field strength meter is unusual in that it combines two features into one instrument. The simple diode f.s.m. requires no uning for any frequency, but it does require a ot of signal to give adequate deflection. By dding a simple tuned circuit on the input side f the meter, it would be very sensitive, but require tuning and a full set of plug-in coils for coverage between 100 kc and 100 mc or higher.

In this meter, an untuned choke input is combined with a highly sensitive d.c. transistor amplifier to provide deflection of the meter from a transmitter up to 100 feet away. With the gain wide open and the sensitivity turned up all the



Circuit of the high gain untuned field strength meter. The CK722 transistors are Raytheon units and RFC1 is 10 Milihenries, (Ohmite R-50 or equiv.). All resistors are ½ watt.

way, the meter was reading half scale from a local radio station two miles away. With the meter in the ham shack on the other side of the room, setting the gain and sensitivity controls at the nine o'clock position, a 100 watt transmitter drove it off scale.

Construction is straightforward; the transistor amplifier circuit is wired on small circuit board, and any component in the circuit could vary 20% without causing any difficulties. If preferred, a cheaper 0-1 ma meter, rather than the 500 microamp unit, could be used with some loss in sensitivity. The two Raytheon CK722 transistors are very inexpensive and any equivalent transistors will work just as well.

With the gain and sensitivity controls turned all the way down, turn the unit on. The needle should deflect in one direction or the other. By adjusting the ZERO control, set the meter to read zero. Then turn the sensitivity control up gradually to full clockwise, re-adjusting the ZERO control as you go. The meter is now ready for operation.

Place the meter somewhere in the room, turn the transmitter on and bring up the gain control until the meter reads full scale. Then bring down the sensitivity control until the meter is reading about half scale. You are now able to observe when your transmitter is peaked up for maximum r.f. output. Later, you can walk around your house and neighborhood to observe the field strength pattern and direction of greatest signal. This trouble free, simplified, untuned, sensitive field strength meter should provide you with a better working knowledge of your equipment *and* a stronger signal where you want it. And by placing 2,000 ohm headphones in the circuit instead of the meter, you will be able to hear your off-the-air a.m. signal.

Crystal Checker

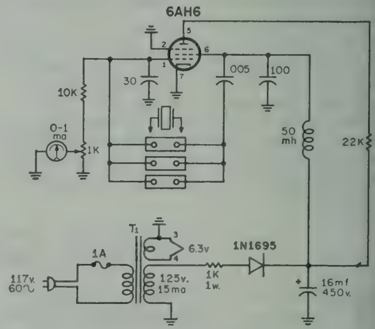
This circuit employs a 6AH6 tube in a modified Pierce oscillator circuit. By using a large radio frequency choke in the screen lead, the circuit will oscillate at very low frequencies besides the high frequency range. When the crystal is plugged into the socket and the circuit oscillates, the grid circuit will draw grid current which can be read on a meter.

A good oscillating crystal will cause from 0.5 ma to 1 ma of grid current. By taking a good crystal and checking the current, you will see that this can be used as a reference for other crystals. A bad crystal will produce a low current and the following is a scale of activity.

0.0 to 0.2 ma—Bad crystal.
0.2 to 0.3 ma—Fair crystal.
0.3 to 1.0 ma—Good crystal.

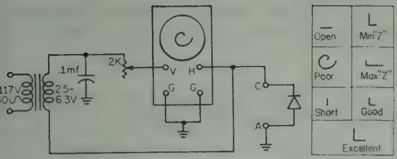
There are no particular precautions to be observed in building this circuit. All of the parts fit nicely into a type #136 LMB chassis box, 3" wide, 5" long and 2" high. The only thing to watch out for is to select a crystal socket or sockets for the type of crystals you think you might like to test. The FT-243 is the most common type. Just leave enough room when locating the crystal sockets so they can be inserted without hitting the tube or meter.

When the circuit is finished, select a crystal that you know is active. Put it in the circuit and set the 1000 ohm potentiometer so that the meter reads 1 ma. When other crystals are put into the circuit they can be compared with this meter reading.



Circuit of the crystal tester. The crystal sockets used are Cinch-Jones KB, Millen 33302 and Millen 33002. Transformer T_1 is a Stancor PS-8415. All resistors are ½ watt unless otherwise noted and all capacitors less than one are in mf; greater than one are in mmf.

Checking Matching Diodes

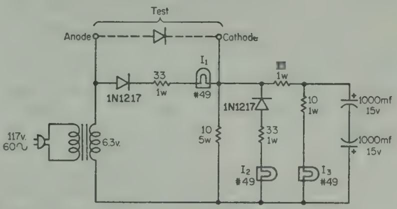


A simple scope setup enabling the checking and matching of diodes.

When checking diodes of the same type, a comparison can be obtained by utilizing the *same* pot setting and noting the relative sizes of the traces obtained. Choice of a transformer is not critical. In addition to the scope traces shown, look for any exhibition of "fuzz" or ripple. Even if the basic trace seems good, do not rely on a diode exhibiting either.

Silicon Rectifier Tester

Three #49 miniature lamps are used to indicate an open, shorted or good diode. When an open diode is checked, I_1 will light; when a shorted diode is encountered, I_2 will light. A good diode will cause all 3 lamps to light up. Nothing could be simpler.



Simple tester for silicon rectifiers. An open rectifier will light lamp I_1. A shorted rectifier will light I_2 and all three lamps will light with a good rectifier.

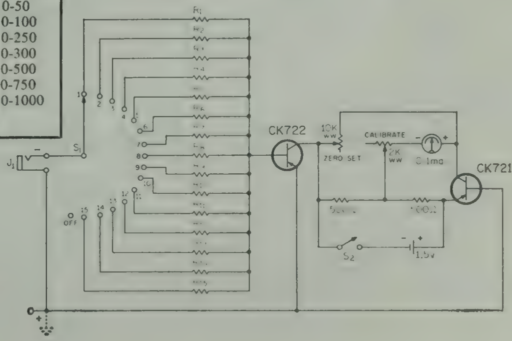
Transistor DC Voltmeter

The circuit utilizes an inexpensive d.c. milliameter connected to a direct coupled d.c. amplifier consisting of two Raytheon p.n.p. transistors. This provides a full scale sensitivity of 10 microamperes.

The input resistance of the device is 100,000 ohms per volt and compares favorably with or exceeds that of commercial units.

Fifteen voltage ranges are shown, but any

Multiplier	Resistance (megohms)	Range (volts)	Multiplier	Resistance (megohms)	Range (volts)
R_1	.10	0-1	R_9	5	0-50
R_2	.25	0-2.5	R_{10}	10	0-100
R_3	.30	0-3	R_{11}	25	0-250
R_4	.50	0-5	R_{12}	30	0-300
R_5	.75	0-75	R_{13}	50	0-500
R_6	1.0	0-10	R_{14}	75	0-750
R_7	1.5	0-15	R_{15}	100	0-1000
R_8	2.5	0-25			



Circuit of a simple transistorized d.c. voltmeter.

number less than that may be used merely by eliminating the multiplier resistors for the unwanted ranges and selecting a switch with fewer positions.

The test lead for J_1 is made from thin coax or shielded wire.

To calibrate the instrument, zero the meter, set the range switch to the 1-volt position. Apply an accurately known source of 1 volt and set the CALIBRATE pot for full-scale deflection.

The entire unit can be built into a standard meter case if desired. Layout is not critical.

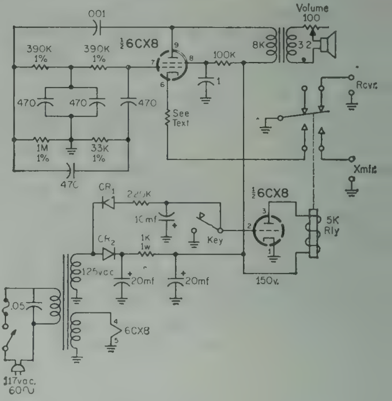
Keying Relay & Monitor

When the key is pressed, the keying tube conducts closing the key relay. The relay has a grounded arm and the two contacts in the closed position operate the monitor and the transmitter. If the relay is in the open position the receiver contacts are closed letting the receiver function; the grid of the keyer tube is blocked by a negative voltage.

The keying relay will clip along just about as fast as anybody desires to send. Just don't turn the chassis upside down or the relay will stay closed because it is full of mercury that shorts the contacts. Keep it mounted in the vertical position.

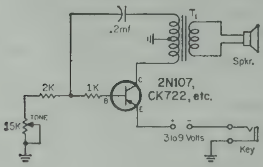
There should be no trouble constructing the oscillator if 1% resistors are used. The capacitors *must* be silver mica; disc type will not work. The value of the cathode resistor depends on the plate voltage used, and it is suggested that a 500 ohm pot be put in temporarily and varied until the oscillator functions. There is also a slight adjustment for tone; a value of 150 ohms peaked the audio just right for my ears.

This monitor keyer unit is small, can be used with any c.w. rig and will improve your sending. Try it!



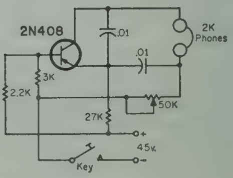
Circuit of a keying relay and monitor. All capacitors with values greater than one are in mmf and those with values less than one are in mf unless otherwise noted. All resistors are ½ watt unless otherwise noted. The diodes, CR_1 and CR_2, are rated at 300 p.i.v.

Code Practice Oscillator



A simple transistorized code oscillator suitable for driving a small loudspeaker. Any inexpensive PNP transistor may be used. Transformer T_1 is a Lafayette TR-109 transistor output transformer.

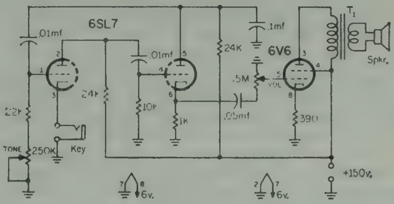
Easy Code Practice Oscillator



An easy to build code practice oscillator. Other transistors that can be used are: 2N109, 2N362, 2N217, and 2N407.

Tube Code Practice Oscillator

Tube type code oscillator using inexpensive parts. The 6SL7 may be replaced by a 6SN7, 12AU7 or any other dual triode while the 6V6 may be replaced by a 50L6, 12A6, 6AQ5, etc. with appropriate changes in pin connections and filament voltage. Transformer T_1 is any 50L6-type output transformer.

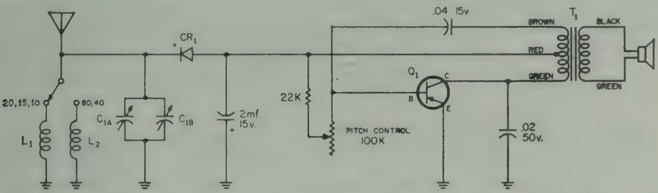


Self Powered CW Monitor

The parts were scrounged from a defunct ransistorized radio. Capacitor C_1 is the tuning capacitor with both sections paralleled. There are no numbers on the transistor; they were rubbed off long ago, but it is a p.n.p. type. I can't decipher the code on the diode either so any type you have will probably do.

If you use an n.p.n. type transistor simply reverse the diode polarity and it will work also.

I originally had intended to power it with batteries, and I haywired the oscillator section together first. Testing it with a depleted pen light cell I had taken out of my Tunnel Dipper; it gave out a weak chirp.



Circuit of a self powered c.w. monitor. Most of the components, speaker included, are salvaged from an old transistor radio.

$_1$—See text.
$_1$—8t. #24 E. on ½" dia. poly rod.
$_2$—40t. #24 E. wound on other end of L_1 rod.

T_1—Lafayette TR-99.
Q_1—Any audio type p.n.p. See text.

Schmitt Trigger

For those of you who do not know what a chmitt trigger is, it is a regenerative bistable ircuit whose state depends on the amplitude of he input voltage. For this reason, it is useful or waveform restoration, signal level shifting, quaring sinusoidal or non-rectangular inputs nd for d.c. level detection. Transistors which an be used in addition to those shown in the iagram are: 2N1217, 2N169A and 2N1694.

See fig. 1 for the circuit which should suit you fine. It has a range of 0 to 1 mc; the output at the collector has a 2 volt minimum change level; Q_1 always conducts if the input exceeds 6.8 volts and Q_2 always conducts if the input is below 5.2 volts. Its ambient temperature range is from 0°C to 71°C.

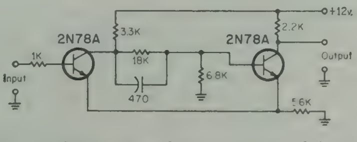


Fig. 1—Schmitt Trigger having a range of 0-1 mc.

10 Minute Minder

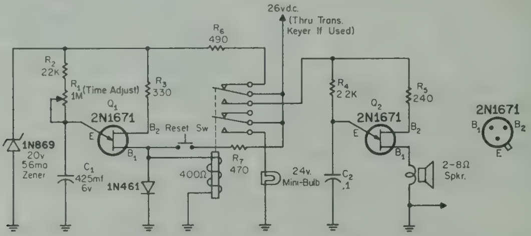
The unit described here, is for a one repeat per second continuously adjustable to one repeat every 12 minutes. Presently this device is used as a "Ten Minute Minder" tone generator with a warning light indicator as reminder for "time to identify radio amateur call" as per legal procedure. It is particularly useful during phone patch operations, long winded QSOs (when set at the three minute time), as a long distance telephone time reminder and also as a "beep" generator for legal recordings.

The transistors are of the unijunction type and basically C-R time adjusted relaxation oscillators. Components R_1 and C_1, in Q_1 were selected for one pulse every second and adjustable to one pulse every 12 minutes, in Q_2, R_4 and C_2 were selected for an audio tone of approximately 600 cycles. Resistor R_2 may be changed to other values for any desired tone.

The output of this tone generator is sufficiently loud to be heard throughout the house despite its surprisingly low current of 5 ma through the 3 inch speaker. For maximum cycling stability the value of R_3 is selected for a 1N869 zener current of 5 ma which is read during charging cycle (off time).

The normal power supply requirement is 25 v.d.c. but 12 v.d.c. may be used providing R_2, R_3, R_5 and another zener diode are selected (lowered) in value to maintain the same current relationship. The lamp circuit is optional, but does provide additional warning where other tones are being heard. The tone and light On period is approximately a 2 second duration and draws 50 ma total current of which the lamp takes 35 ma and the remainder for the conduction time of both Q_1 and Q_2. Rest period or charging time is only 5 ma.

The complete unit may be housed in a small defunct transistor radio case and the usual miniature phone jack, used as the input for the power supply voltage which may be coming directly from a 25 v.d.c. source or through the transmit relay source of the transmitter if on the air timing is required. The reset switch may be used at any time to start and time an operation.



The circuit of the "Ten Minute Minder" makes use of two Unijunction transistors. All resistors are ½ watt and all capacitors are in mf.

Phone Patch

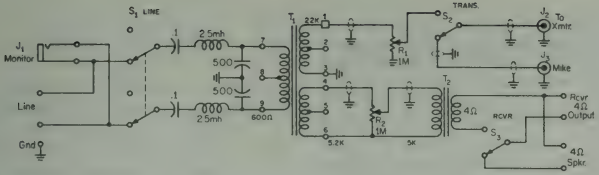
The main transformer (T_1) was mounted on metal spacers but it may be mounted in almost any convenient manner. When mounting, make sure to position the square terminal on the transformer correctly for shortest leads. A solder lug was placed under one of the mounting screws for a convenient ground.

The MONITOR jack (J_1) must be mounted with insulated shoulder washers so as to isolate it from ground. It may be mounted to the right of the mike and transmitter connectors on the rear apron. This jack is used to plug in a db meter, a telephone, *etc.*

The connections made from the receiver, speaker, phone line, and ground, to the patch, can be made to any type of terminal connector or block mounted on the rear apron. (I used an 8-terminal barrier strip taken from the junk box.)

All wiring except the receiver switch (S_3) was done with twin conductor cable. The receiver switch was done with 3 wire cable. Wires twisted together will also suffice for these cables. The transmitter and mike cables from S_2 may be routed between T_1 and the chassis side to their respective connectors. The wire from R_1 to S_2 should be kept as short as possible so as to minimize pick-up.

The bottom plate is sheet metal held in place by twelve #8 sheet metal screws. Four rubber feet are mounted on this plate.



Circuit of the $10.00 phone patch is extremely simple. Transformer T_1 is a World Radio Lab #XD233 d T_2 is a 5K to 4 ohm output transformer. Connectors J_2 and J_3 may be of the type shown or multiple circuit nnectors if a p.t.t. mike is used. The two gain controls have an audio taper and except for the bypass capacitors which are in mmf all other capacitors are in mf.

Operation

One requirement of this patch is that the ceiver be muted. If it is not, there will be a rect path between receiver output and trans- itter input. If it *is* muted, no switching of the ıtch is necessary when shifting between transmit ıd receive.

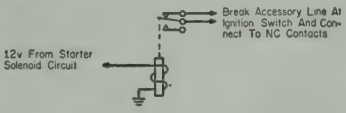
Because three separate switches were used, ther than one 4-pole switch, much operation exibility was obtained. To turn on the patch. is only necessary to place all three switches $_1$, S_2, and S_3) in the ON or up position. With e audio gain on your transmitter set in the ɔrmal position for your crystal mike, the patch ansmitter gain control (R_1) may be adjusted as to allow the party on the phone to properly odulate your transmitter. When your patch is tuned up in this manner, you may shift your transmitter switch (S_2) to the NORMAL position (down) when identifying your station. This will prevent the high output of the telephone mike from over-modulating your transmitter and also prevent the party on the phone from interrupting. If you desire to let the person on the phone listen to your conversation with someone, without allowing him to modulate the transmitter, the RECEIVER and LINE switches (S_1 and S_3) may be placed in the up or ON position, and the TRANSMITTER switch (S_2) left in the NORMAL position (down). Also, if it is necessary to talk to the party on the phone while receiving, the line switch (S_1) may be turned off. This completely quiets the receiver so you can talk. Also, this may be done in the same manner while transmitting.

Mobile Access Cutoff Circuit

In the author's Corvair the radio, wipers, back- lights, heater and air conditioner are con- olled by the ignition switch, also any mobile g that may happen to be installed. On any given ip, 3 or 4 of these accessories are usually on. 'hen the car is stopped and then re-started it is lvisable to turn off these accessories, particu- rly the air conditioner or mobile rig. However, turn off these items and then turn them back ı every time the car is started is rather trouble- ɔme.

The simple circuit shown eliminates the prob- m by turning off the accessories when the ıgine is being started. One heavy duty relay is ed. It must be rated for the full accessory cur- nt and have normally closed contacts. Al- ough a commercial unit is specified, any surplus 12 volt d.c. relay meeting those specifications would be satisfactory.

The leads which carry the full accessory current should be of wire the same gauge or heavier than that used for the auto ignition switch wiring.


Break Accessory Line At Ignition Switch And Connect To NC Contacts
12v From Starter Solenoid Circuit

This simple circuit relieves the battery of the accessory load current when starting the car. The relay is a Potter Brumfield PR5D. Any surplus relay with a 12 volt coil, whose contacts can handle up to 25 amps, will do as well.

Variable-Heat Soldering Iron

The iron is built in a 9 × 6 × 5″ aluminum tility box as shown in the photos. The sche- atic diagram is in fig. 1. When soldering the ariable transformer into the circuit, be sure to connect to the proper terminals or the unit simply will not work. Also be sure a 3 ampere fuse is in the holder. The pilot light, P_1, consists of a neon tube and a built-in resistor. If desired, you can use an NE-2 and a 100k ½ watt resistor instead. The iron itself is a miniature commercial type made by Oryx and operates at only 12 volts. Thus leakage into any transistor circuit is limited to this value. C_1 is used to balance the 12 volt winding and reduce any hum transmission. If it is not used, do not connect the center tap to the chassis, but rather cut it flush with the transformer case.

When construction is complete you can turn on the unit and check its operation. with the variable transformer set to maximum, the iron should reach full heat in about 1½ to 2 minutes. Reducing the transformer output will vary the heat and the iron can be used in the customary way.

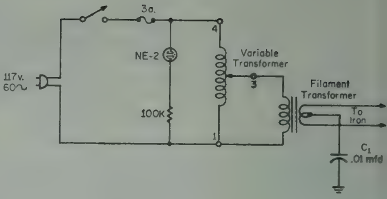


Figure 1—Schematic diagram of a variable wattage soldering iron for v.h.f. construction enthusiasts. Variable transformer shown above is actually a powerstat controlling the voltage to the iron.

Bill of Materials

1 Oryx Model 25 miniature industrial soldering iron.
1 12 volt filament transformer center tapped. (3 amperes).
1 Superior Electric Company type 10 powerstat.
1 NE-2 neon light assembly (Drake type 105).
1 SPST toggle switch.
1 3 ampere Little Fuse with panel holder.
1 Utility cabinet 9 × 6 × 5 (Bud CU-1099).
1 .01 mfd disk ceramic capacitor.

Built-In Modulation Monitor

Many CB enthusiasts are experimenting these days with modulation limiters, purchased either ready made or in kit form. With little or no test equipment, however, the average Charlie Brown is usually hard put to tell how his set sounds with and without limiting, and must rely on the too often vague and unsatisfactory reports he can elicit from on-the-air contacts.

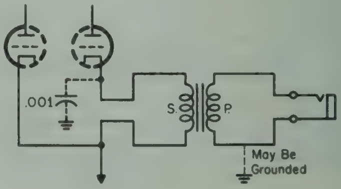
But there is a fairly simple and quick way one can listen to his own modulation while adjusting limiters, substituting microphones etc. All it requires is an inexpensive plate to voice coil output transformer and a pair of earphones. Such transformers are rated according to the impedance of the speaker they are designed to match, i.e., 4, 6, 8 ohms and so on. If there is any choice, the higher impedance one should be chosen, as it will tend to give more volume in the earphones.

The transformer should be placed as close to the final RF tube as space will allow. The secondary winding (usually heavier, solid leads) is connected in series with the final RF tube cathode as shown in the diagram, with as short leads as possible. The primary leads then go to the earphones. The length and placement of the latter are not critical, and depending on the type of set, a phone jack or a pair of binding posts can be mounted on the front or rear of the cabinet, or simply a pair of twisted wires running through a hole or louver can be used.

Normally, such an installation does not effect the operation of a transceiver at all, but as a precautionary measure a .001 ufd capacitor can be placed directly from the cathode of the RF tube to ground to help keep the RF where it belongs.

With earphones connected, the results of substituting mikes, limiter adjusting etc. can be plainly heard. It should be remembered, though, that the purpose of a modulation limiter is to boost the average per cent of modulation, *not* to allow the CB'er to talk 3 or 4 feet back from the microphone. Inevitably, if the mike is not close-talked, room echo sets in, making the signal unpleasant to listen to and difficult to understand.

Acoustics within the microphone must be watched as well when trying different cartridges. Too much empty space within the mike shall sometimes give rise to unwanted resonance or echo effects. Remedy is to fill the extra space with wads of cotton.



$5 Field Strength Meter

Really, haven't you ever wondered if your rig was getting out—don't you sometimes think that you're calling into a dead microphone? A field strength meter will cure this—plus several other ailments to boot!

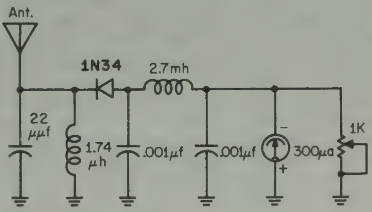
A field strength meter is simply a sort of S-meter which gives a relative reading of your own transmitter's signal strength. It consists of a crystal diode to detect your signal, a tuned circuit to weed out undesired strong signals which could give the meter problems, and (natch) a meter. It is rather insensitive a gadget and will not detect a CB signal from much further than you can throw a monkey wrench. When you press your PTT button the needle on the meter promptly pops up. Since you are able to vary the sensitivity of the meter, the writing on the meter scale is of no particular significance other than as a source of relative signal strength.

CONSTRUCTION

The FSM isn't too big a project to construct, we built ours in a small plastic box, but just about any handy container will suffice, even a tin can!

The relatively few components can be mounted on a three or four point terminal strip inside the container. The meter movement is a microammeter, I used a 300 ua movement in mine, but I would imagine that you could use just about any size down to 0 ua—the lower rating should be used if you intend utilizing this FSM with a 100 mw rig. You'll find that meters tend to be somewhat on the expensive side but ours, at $2.45 (Lafayette 99-G-5028), is about as inexpensive a meter as can be obtained (unless you can scrounge one from a junk box or military surplus shop. The meter is less than an inch square and will allow you to construct your FSM in something like a frozen juice can.

The antenna I used was a short length of bell wire, insulated. The exact length isn't very critical and will depend upon the placement of the FSM in relation to your rig. If you use the FSM in your mobile unit, place the meter on top of the dashboard and drop the wire antenna out of the way into one of the defroster vents.



PARTS LIST

1	**1N34 diode (Lafayette 19-G-4901)**
2	**.001 ufd capacitors (Lafayette 32-G-0943C)**
1	**22 uufd capacitor (Lafayette 32-G-0943C)**
1	**1000 ohm potentiometer (Lafayette 19-G-6142)**
1	**1.72 uh choke (Miller RFC-144)**
1	**2.7 mh choke (Miller 975)**
1	**Microammeter (any from 50 to 300 ua)**
	Case, terminal strip, wire

IN OPERATION

With your mike button pressed, and the antenna of the FSM placed so that you get a ¾ meter reading with the sensitivity potentiometer opened about ¼ to ½, you have a fine reference spot. Take a crayon and mark the meter cover to indicate this reading, also the position of the sensitivity control. Unless you move your FSM antenna, the meter reading should remain the same each time you go on the air. If it shows any more than a drop of a few degrees, then you may have something out of tune or out of whack in your rig, or possibly in your antenna or transmission line. At least you know that something requires your attention!

Modulation Checker

Ever wonder if perhaps your ultra super-fantastic modulation might be pushing you over to the *wrong* side of the law? Don't forget that Uncle Charlie is very emphatic about the fact that you shouldn't run more than 100% modulation—he even sends out little nasty monetary forfeitures and "Show Cause" notices to errant CB'ers.

Here's a way to check on your own modulation, it's a little gadget which throws together in one evening and takes up very little space. It's the MOD-U-MON. Construction isn't critical, and once you set the single adjustment, it shouldn't require any further tinkering.

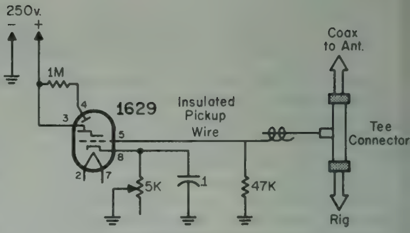
Our gadget is put together in a small Minibox (you can even mount it on the front panel of your CB rig, if you have the room to mount it and the intestinal fortitude to drill into the panel). The central component of the circuit being a type 1629 "magic eye tube," we will mount the tube in an Amphenol 58-MEA-8 tuning eye mounting assembly. The 1629 tube is a standard 12 volt filament magic eye tube which is carried by many large supply houses. The schematic shows that there are relatively few parts involved, so there is no point in belaboring any intricate construction details for the MOD-U-MON. You simply can't go wrong if you watch what you're doing!

The power necessary, 250 volts and 12 volts, is easily obtainable from just about any piece of communications gear—even your own CB rig.

The MOD-U-MON is attached to your rig in the following manner. A "Tee Connector" (Amphenol 83-1T) is inserted in your coaxial lead in by means of two PL-259 connectors. A nail is then placed in the output of the Tee and the pickup wire from the MOD-U-MON is then wrapped around the nail.

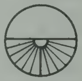
OPERATION

With the power turned on in the MOD-U-MON, adjust the 5K pot until the eye of the tube just closes (with your transmitter still off the air, at this point). Now turn on the transmitter (with the mike button depressed) and adjust the pickup wire coupling around the nail until the "eye" of the 1629 tube opens to allow a wedge shaped dark area of about 90° in width. Now modulate your rig.

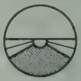


PARTS LIST

1 .1 ufd capacitor
1 47K ½-watt resistor
1 1 Meg ½-watt resistor
1 5K pot
1 1629 Magic Eye tube
Misc: Amphenol 58-MEA-8 housing, Minibox, Tee Connector, 2 PL-259 connectors, nail, wire.



100% Mod.



No Mod.

As you talk, the "eye" should open and close with the modulation, and the more you modulate, the more the "eye" will close. When the "eye" is closed all the way you have achieved 100% modulation. Safety says that you should operate *just below* this point.

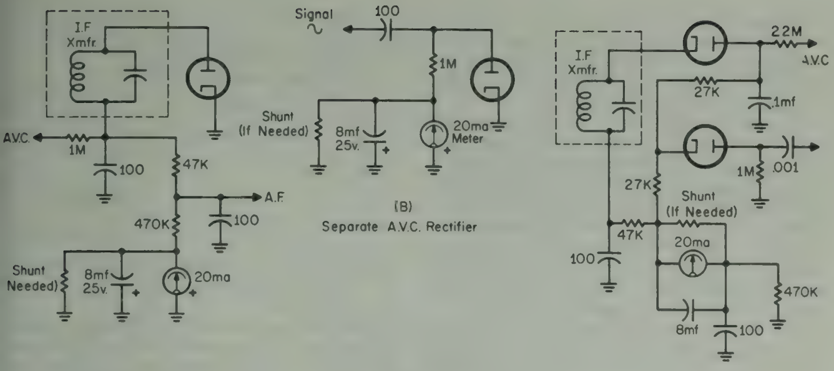
Tuning Meter Circuit

Most receivers incorporating a tuning meter also have a diode detector—AVC rectifier, and obtain signal strength indications by measuring the AVC voltage by some means. This voltage, with most receivers, has a maximum value of up to 40 volts with the strongest signals; and the AVC voltage varies approximately as the logarithm of the signal strength.

Inspection of a number of diode detector—AVC rectifier circuits shows that the resistance between AVC takeoff point and ground is from about .5 to about 2 megohms. In consequence, maximum current in the circuit, resulting directly from signal rectification, is from 80 to 20 microamperes—well within the range of a standard panel meter—so that direct measurement of signal strength is entirely feasible. All that is needed is a microammeter having a range of 20 or more microamperes, some sort of an AF filter, and a shunt (in some instances) to reduce the meter reading somewhat.

Connection of the meter to various diode circuits are shown in Fig. 1. The most common circuit is shown in 1A, with the meter connected at the ground end of the resistor string. Audio pulsations are kept out of the meter by use of an 8 uf. 25 volt capacitor; and the range of the meter is reduced, if necessary, by a resistive shunt. As the meter movement has quite a bit of inertia, the damping capacitor need not be as large as a simple R-C computation would suggest.

Where a separate AVC diode is used, meter connection is as in Fig. 1B, the same value of damping capacitor being adequate. With the relatively new and highly effective Makino detector—noise limiter, meter connections are shown in Fig. 1C. The meter will work equally well with this circuit if it is inserted in series with the upper 27k resistor, will read slightly higher on a given signal if so connected, but will also respond slightly more to noise pulses.



(A)
Diode Det.–ANL

(B)
Separate A.V.C. Rectifier

(C)
Makino Det.–ANL Circuit

Fig. 1. Tuning meter connections.

As both of these effects are very slight, convenience, rather than theory, will tell where to connect the meter.

Choice of the tuning meter range to specify depends upon the current in the diode circuit and is quite simply computed by use of Ohm's Law, once the AVC voltage on the loudest signal likely to be received is measured. Use a VTVM for this measurement, not a 1,000 ohms per volt test set.

If the current in the diode circuit is 20 microamperes or more, as is almost always the case, insertion of a tuning meter is practicable. Standard calibrations are 0-20 and 0-50 microamperes. Most small receivers will be in the 20 microampere range, while larger receivers (RF and 3 IF) are likely to have over 50 microamperes in the diode circuit. Because a 20 microampere movement, which has a resistance approximating 4750 ohms, has a better damping characteristic when shunted to read 50 microamperes full scale than a 50 microampere movement used "barefoot," a shunted 20 microampere movement is usually best for tuning meter applications, despite its slightly higher cost.

Insertion of a meter in the diode detector circuit of a receiver seems to provide the simpliest tuning meter circuit, requiring only the meter, a damping capacitor, and (sometimes) a shunt resistor. It reads "forward," giving a higher reading on a stronger signal, and has the roughly logarithmic characteristic inherent in any AVC-controlled receiver.

Additional blessing with this circuit is the absence of any need for adjustment as the tubes age; and the similar absence of warmup surges which pin the pointer on so many bridge type signal strength meters. Once installed, a diode circuit tuning meter is very likely to operate continuously, without servicing.

TVI Detection Unit

Besides the fact that it's illegal to radiate a CB signal outside the confines of the CB frequencies, the TVI which is frequently caused by these unwanted signals constitutes a social (and frequently a health) hazard to the poor CB'er. Of course, it is often the case that TVI is the result of a CB rig in the neighborhood, but not because of any fault of the CB operator or his rig. Some TV sets just aren't capable of rejecting CB signals from their IF strips and "10-4's" pour in all over *Bullwinkle Moose* and *Katy Winters*.

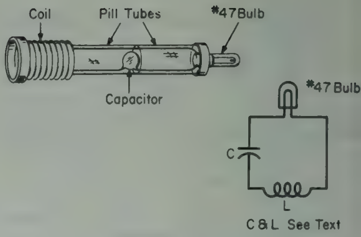
Frequently, by the time the CB'er has determined that the TVI is not due to any improper operation of his rig, he has frequently invested considerable money in low pass filters—all to no avail, because if there was nothing wrong with his rig in the first place, all the corrective measures in the world won't make any difference to the TV receiver.

The little gadget described here costs a few pennies to construct, or no pennies if you happen to have some of this common radio material around your shack. It is capable of sniffing out whiffs of TV Channel 2 TVI in your transmitter—and you can be certain that if it lights up then you are flirting with trouble with both your neighbors and the government.

All it is is a fixed-tuned absorption wavemeter tuned to TV Channel 2. When you flip on your carrier and hold the device near the tank coil of the transmitter, the bulb in the circuit will glow if the circuit senses TV Channel 2 interference coming out of your rig—and TV Channel 2 is by far the most common problem with CB'ers because it is on 54 mc/s, the second harmonic of a 27 mc/s CB signal.

The *TVI Sniffer* is housed in a 9/16" plastic pill container 2" long (actually two of them back to back to equal 4"). Around the top end of one of the containers we wind 8 turns of #22 enamelled wire in a coil 1/2" long. The bottom of the container is removed. To one of the leads (which should be kept as short as possible, and run inside the tube by means of two holes on opposite sides which are made with a heated pin) solder a 10 uufd mica or ceramic capacitor.

Into the cap of the second plastic tube, a #47 pilot lamp is fit. Cut the cap so that the lamp makes a sung fit. Two wires are then soldered to the bulb. Cut off the bottom of the tube, then place the cap on the tube and solder the two wires from the bulb to the wires from the coil—still keeping the leads as short as possible. The two plastic tubes are then welded together by plastic glue. That's it. If you have a grid dip oscillator you can double check the operation of the device by seeing if it resonates at 54 mc/s. One turn more or less on the coil should be sufficient to bring the unit into resonance—take off a turn to raise the resonant frequency, add one to lower it.



With the transmitter on, and the mike button pushed, slowly advance the *TVI Sniffer* towards the tank coil of the transmitter. The bulb end should be in your hand, with the coil end towards the tank coil. It will not be necessary for you to actually touch the tank coil with the TVI Sniffer—but if the bulb starts to glow you can be pretty well certain that somebody, somewhere is enjoying CB the expensive way—on a TV receiver. Naturally, you are expected to exercise reasonable caution when doing any poking around high voltage transmitter circuits.

VHF
TRANSMITTERS

6 Meter Walkie Talkie

The detector, Q_1, a Philco 2N1499A operates in a degenerative mode and has a gain well over a million in addition to near perfect a.v.c. Resistors R_1 and R_2, R_3 and R_4, determine the operating point for the detector. Resistor R_4 is made variable to control super-regeneration. The receiver is tuned by varying C_1, which changes the resonant frequency of L_1. Audio output from the detector is coupled to the amplifier via transformer T_1. A quench filter consisting of C_2, C_3 and R_5 prevents the high frequency quench signal from overdriving the amplifier. The antenna is transferred from the receiver to the transmitter by means of one section of a 4p.d.t. slide switch. The transmitter section consists of a crystal controlled oscillator (Q_2, a Philco 2N1499A (MADT), driving a common emitter power amplifier, another MADT-type 2N1749. The oscillator is crystal controlled by means of a fifth overtone "rock". Tuning is accomplished by C_4 in the oscillator and C_6 in the power amplifier. Drive from the oscillator is coupled to the final by C_5 which acts as a capacitive voltage divider to impedance match the two stages. The final operates class C and provides a power gain of 10 db at this frequency. Efficiency is approximately 50% since the stage delivers about 25 milliwatts with a d.c. input of 50 milliwatts.

The amplifier/modulator is a two-stage *R-C* circut employing two 2N224 transistors (Q_4 and Q_5). A small portable radio speaker is used normally on receive, and as a dynamic microphone when transmitting. The final is Heising modulated at a level of about 90%. Diode CR_1 and capacitor C_8 protect the final amplifier and act as a form of speech clipper. A 4p.d.t. slide switch serves to transfer the circuits between receive and transmit.

No particular construction details other than coil winding data is given. The circuit layout should not be critical although the conventional practice of very short leads in the receiver and transmitter section should be observed. The unit can be completely self-contained in a 5½ × 3 × 2⅛ aluminum minibox. The compact nature of the receiver would lend itself to printed circuit techniques for the ambitious constructor. The receiver should be shielded and a small shield plate should be used between the oscillator and final amplifier in the transmitter. Regeneration is controlled by varying R_4 and it should be adjusted, along with C_1, for best reception. The transmitter should be peaked up by tuning C_4, C_6 and C_7 for maximum field strength. Loading coil L_6 can be adjusted for maximum field strength by spreading and compressing turns. On receive, the battery current should be approximately 15 ma and on transmit, the current should be approximately double this figure.

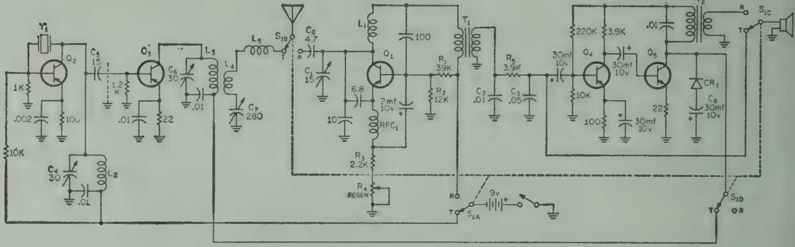


Fig. 1—Complete schematic of a six meter handie-talkie. All resistors are ½ watt. All capacitors greater than one are in mmf and less than one in mf unless otherwise specified.

C_1—15 mmf variable, Hammarlund MAPC-15 with 4 plates removed.
C_4, C_6—4-30 mmf trimmers.
C_7—280 mmf compression trimmer. ARCO #464.
CR_1—1N34A diode or equivalent.
L_1—10 t. #16e. ⅜" i.d.
L_2, L_3—8 t. #16e. ⅜" i.d.
L_4—2½ t. #20 plastic hookup wire over L_3.
L_5—9 t. #20 plastic hookup wire ¼" i.d.
Q_1, Q_2—2N1499A.
Q_3—2N1749.
Q_4, Q_5—2N224.
R_4—5K miniature pot. Regeneration control.
RFC_1—6.8 μh choke. Ohmite Z-50.
S_1—4 p.d.t. push-button switch. Lafayette SW-92.
T_1—Transistor driver transformer 20K to 1 K. Argonne AR-104.
T_2—Transistor output transformer 1 K to 3.2Ω. Argonne AR-138.
Y_1—5th overtone 6 meter crystal.

1 Tube On 6

When you've finished wiring the chassis and checked for possible errors, connect the batteries or power supply and mike, plug a crystal into the socket, and a dummy load into the antenna jack. A suitable dummy load for testing can be made from a #47 pilot lamp fitted into a coaxial connector. If you are using 50 mc crystals, start with L_1 at minimum inductance, (slug all the way out). Adjust L_2 until the lamp begins to glow. Next, adjust C_6 for maximum brilliance. Keep adjusting L_2 and C_6 alternately for maximum output, and trim up L_1. Speaking into the microphone should cause the lamp to flicker noticeably. When using 8, 16, or 25 mc crystals, the setting of L_1 before oscillation will take place, becomes a little more critical. Start with the slug of L_1 about halfway out, and then proceed as before. Inductor L_1 is always tuned slightly above the crystal frequency, and its setting is not critical. Once set, it need not be touched again.

When coupling to an antenna, either monitor the plate current or check output with a field strength meter or receiver "S" meter. The latter method is preferred. Settings for L_2 and C_6 will be slightly different than with a dummy load. Couple as tightly as possible to the antenna for best modulation. Loading can make a lot of difference in the way a grid modulated transmitter sounds and gets out.

Output, with the power supply shown, is approximately 1 watt. This may not seem like much, but distances of 10 miles and more have been covered with 5-9 reports.

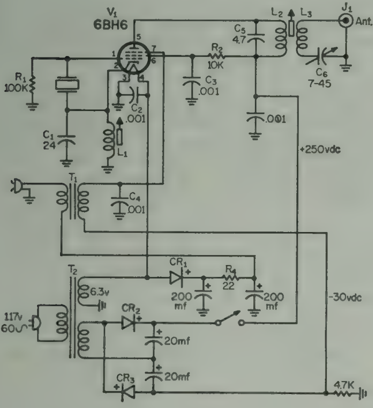


Fig: 1—Circuit of the one tube six meter transmitter. Adequate audio is obtained from the carbon mike and output transformer to modulate the 6BH6. All capacitor values greater than 1 are in mmf; less than 1, in mf unless otherwise noted. All resistors are ½ watt.

CR_1, CR_2, CR_3—Silicon diodes 500 ma, 400 p.i.v. Sarkes Tarzian M500.

L_1 — 5t #24 on ¼″ diam. slug tuned form, close wound. J. W. Miller #4500 form.

L_2 — 8t #24 on ⅜″ diam. tuned form, close wound. National XR91 form.

L_3—2t #18 wound over cold end of L_2.

T_1 — Output transformer, 10K to 3 ohms. Thordarson 24S84 or equiv.

T_2 — Power transformer 125 v.a.c. @ 25 ma, 6.3 v.a.c. @ 1 amp., Stancor PS8416 or equiv.

10 Watts On 6

The circuit shown in fig. 1 employs standard 8 mc crystals, keeping its simplicity by use of a double-ended oscillator plate tank inductor which will properly couple into the p.p. grid circuit of the push-push doubler final. Excellent efficiency is secured from the 12AU7 inasmuch as this is the main feature of push-push doublers. The modulator, by the way, can be used separately with any low powered transmitter whose input doesn't exceed 10 watts. The modulation transformer, T_1, is an inexpensive 8 watt p.p. output transformer. The voice coil winding is not used. The modulator requires a high impedance crystal or ceramic microphone. The 1 meg potentiometer in the second stage serves as the AUDIO GAIN control. Going back to the r.f. unit, the output circuit features a pi-network tank. This will help eliminate TVI and will work well into a low Z transmission line.

Coil L_1 should resonate at 25 mc. Twelve turns of #16 enameled wire on a 1″ diameter form should do the job. This coil is center-tapped as shown in the schematic. The r.f.c. connected to this point can be either a 500 μh video coil or a 1 mh r.f.c. Coil L_2 is a 5 turn air-wound inductor whose inner diameter is 1″. It is made from #12 enamel or bus wire. Tune-up is simple. Adjust C_1 for maximum output as noted with a grid dip meter. Next place the final amplifiers into their sockets and apply power to the rig. If load-

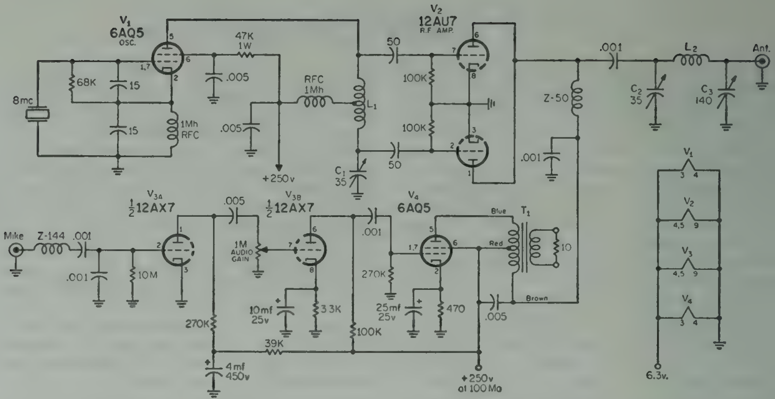


Fig. 1—Schematic diagram of the 10 watter for 6. The 12AU7s act as push-push doublers providing output at 50 mc from 8 mc crystals and require no neutralization. The modulator is straight-forward and can be employed separately in other transmitters with no more than 10 watts in the final. Coil data may be found in the text. All capacitors are in mmf unless otherwise stated and all resistors are ½ watt.

ing into the antenna, observe forward power on your s.w.r. bridge and tune both the oscillator and final amplifier capacitors (C_1 and C_2) for maximum output. Adjust loading with C_3. A suitable dummy load for tune-up can be made from two 47 bulbs in series. APC-type tuning capacitors can be used for both the oscillator and final circuits. All capacitors in the balance of the circuit should be silver micas or ceramics. Keep all leads short and direct. Other tube types can be employed in the oscillator stage if desired. Tubes such as the 6CL6, 6BQ5, 5763 and 6AN5 are ideal. In the p.a. stage, the 12BH7 is a little more rugged and has a higher plate dissipation.

Transistor Pre-Amp for 50 Mc: Here's another goodie for the tinkerers with a grid dip meter and a 12 volt battery. We can't supply you with too much information at this time, but suffice it to say that the preamplifier shown in fig. 2 has a low noise figure and will provide about 12 db gain. L_1 is made to resonate at 50 mc with a 15 mmf capacitor tapped ⅓ of the length from the grounded end of the coil. The Philco T2028 transistor is readily available through Allied Radio at $4.50. It can be constructed in a small minibox inside the station receiver.

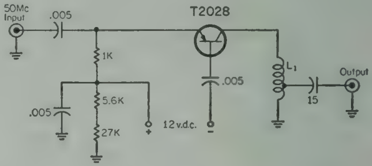


Fig. 2—Simple one transistor 6 meter preamplifier providing 12 db gain. Coil data may be found in the text. All capacitors are in mf unless otherwise stated and all resistors are ½ watt.

12 Watts On 6

Construction is simple and should present no serious problem. Parts placement in a v.h.f. transmitter is ruled by short leads; all bypass capacitor leads should be less than ½-inch long. The use of ceramic disc-type capacitors is also where a v.h.f must. In mounting tube sockets, be careful to orient them properly. Coils L_1 and L_2 are both slug tuned ¼ inch chassis mounted types. Be careful not to ground the plate tank tuning capacitor. A non-metallic extension shaft should be used to adjust C_1. Inductor L_4 should be tightly wrapped around the cold end of L_3. Use insulated wire, connecting one end to C_2 and the other end to the antenna output connector.

The modulator leads should also be short and care should be taken to keep them away from r.f. circuits to prevent feedback. The modulator choke used is a surplus power supply choke; however, a commercial audio re-tor would also be effective.

Filament wiring should be shielded and ounded at both ends. Any audio leads that ve a long run (3 inches plus) should also shielded. B plus and filament leads were ought to the octal socket. When constructed a single chassis, direct wiring is advised.

Power supply requirements are easily met a 300 volt 150 ma supply. By inserting a itch in the center tap lead of the power nsformer, the B plus may be controlled. If double pole double throw switch is used, e other side can control the receiver and tenna switching relay.

In construction, step by step testing is adsable. Build the power supply first and use nporary connections at reduced voltages for nsmitter tests. The filaments should be wired d tested first. Fire up the oscillator and use receiver to listen for maximum output at 25 c (depending on the crystal frequency). Next, just the doubler stage for output at 50 mc. ter wiring the final antenna circuits, apply e reduced voltage through the Z-50 r.f. choke. suitable dummy load is made up of 4 #46 or 47 bulbs wired in parallel and soldered to a standard antenna connector. After satisfactory r.f. output is obtained, finish wiring the modulator. The completed transmitter when modulated should show an upward indication to the dummy load.

Next, apply 300 volts to the completed transmitter. It may be necessary to readjust the oscillator, doubler and final slightly to obtain maximum output. Check for self-oscillation by briefly removing the crystal during operation. No trace of r.f. should appear at the antenna. If neutralization is necessary, use a 3 to 4 turn gimmick connected from the cold end of C_1 to V_2 grid. After thorough testing on the dummy load, you are set to put the "Li'l One" on the air. For final tune up and antenna matching, I used an old favorite—the "Snortin Mortin[1]" c.w. monitor. An s.w.r. bridge is also a good way to load up.

To the experienced v.h.f. amateur, this may seem a very old-fashioned rig—no transistors, no diodes, no meters. Keep in mind the low cost and simplicity of design. On the air reports have been excellent. This is the proof of the pudding. Last but not least—no TVI.

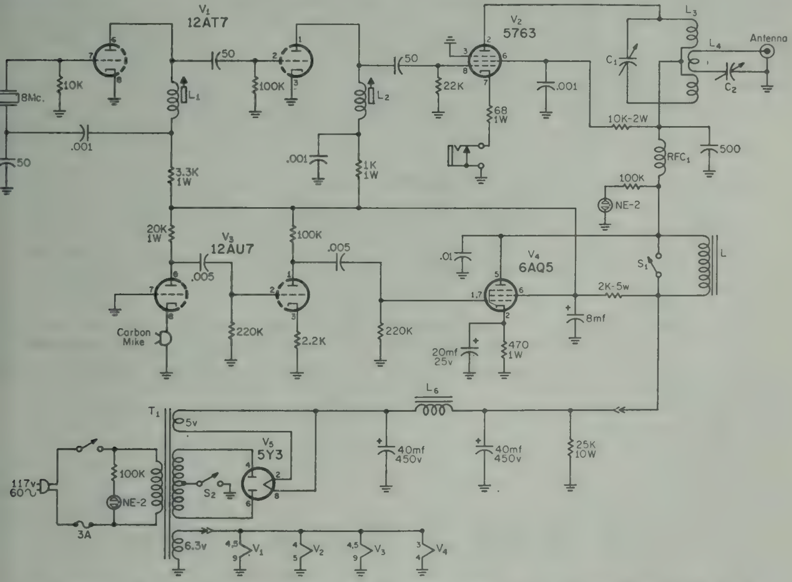


Fig. 1—Circuit of the 6 meter transmitter and the power supply for fixed operation. Switch S_1 is for C.W.-Phone. All capacitors less than one are in mfd, more than one in mmf and those polarized are electrolytics. All resistors are ½ watt unless otherwise marked.

—APC 50 Hammarlund or equivalent.
—30M11 Johnson or equivalent.
—27 t #26E on ¼" slug tuned form.
—10½t #26E on ¼" slug tuned form.
—5t c.t. B & W 3010 stock.
L_4—3t insulated hook up wire on cold end of L_3.
L_5, L_6—Filter chokes as explained in the text.
RFC_1—Ohmite Z-50.
T_1—700 v.c.t. at 150 ma, 6.3v, 5v. (TV surplus).

15 Compact Watts on 6

The tuning unit is completely stripped except for the four prong plug on the back which can later be used to connect to the power supply. Two subchassis are used, one for the modulator and the other for the r.f. section. These two chassis are prefabricated before mounting on the main chassis. An aluminum plate is cut to the size of the front panel to cover up the holes that are not used. After accumulating the required parts for the rig they should be laid out on the chassis so that proper placement can be obtained without interference with other parts.

Adjusting the rig is quite simple. Connect a power supply delivering 250 to 400 v.d.c. at 100 ma and 6.3 volts at 1.9 amps. All the coils should be tuned to their proper frequency with the aid of a grid dip meter before applying power. With the cover off, an 8 or 25mc cryst plugged in, and an open plug or insulated r in the cathode jack of the final, apply pow to the rig. With a grid dipper or a v.t.v.m. r probe in the vicinity of the doubler output co adjust the oscillator coil slug first then t doubler for maximum reading. Check for c cillator stability by cutting the power on a off. Now remove the plug or rod from t cathode jack and with a dummy load or anten connected, adjust the final for maximum br liancy of the neon lamp. The audio is adjust by getting a local amateur on the air and a justing the modulator gain to a point just bel where the audio starts to break up or becon muffled.

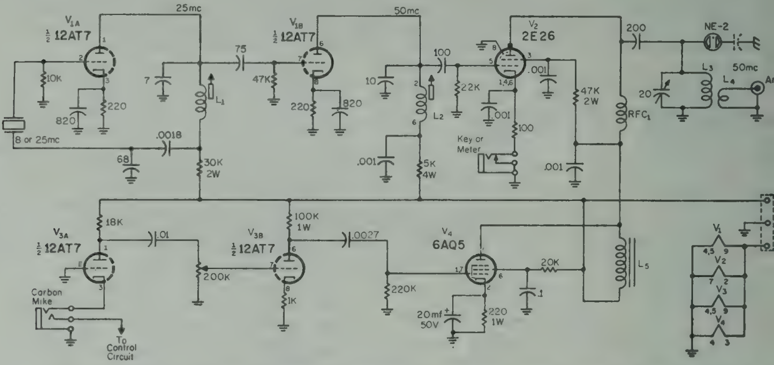


Fig. 1—Circuit of the compact 6 meter transmitter. All capacitor values greater than one are in mmf, less than one in mf unless otherwise indicated. All resistors are ½ watt unless otherwise noted.

L_1—24 t #26 enameled, close wound on ¼" diameter slug tuned form.

L_2—4 t B&W 3008 Miniductor coil stock.

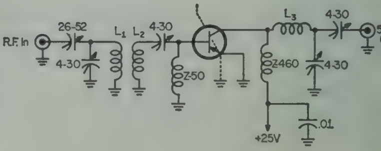
L_3—6 t B&W 3007 Miniductor coil stock.

L_4—2 t #24 plastic covered, wound on cold s of L_3.

L_5—ARC-5 receiver B plus filter choke.

15 Watt 6 Meter Linear

Fifteen watt power amplifier for 50 mc using one of the new Motorola high frequency power transistors. L_1 and L_2 are 4t. #16, 1" dia. ½" l., spaced ⅛". L_3 is 3t. #12, 1¼" dia. ⅜" l.



25 Watt 6 Meter Linear

Do not fail to ground pin 2, the inner shield of the 837! Around 51 mc the linear will tend to oscillate.

With no excitation, the cathode current, per tube, is very low. It varied (with different 837's) from zero in the driver to 4.5 ma per tube in the final with 700 volts on the plates. With the 2½ watts input from the Sixer, the cathode current rises to about 45 to 50 milliamperes per tube and upon modulating the Sixer, the current rises to about 120 milliamperes total in the final. Do not exceed 150 ma.

The coils were formed about a size D flashlight cell, expanding a little when removed from this form. Further coil data is given in fig. 1.

To power the 12 volt heaters, the primaries of two 6.3 volt filament transformers were paralleled, while the secondarys were put in series. (Be sure they are connected in the correct phase or the output voltage will be nil.) The secondary current rating should be from 2.5 to 3 amperes.

The final 837's are mounted horizontally with the sockets located on the shield plate between the two stages. This reduces the lead length between the cathodes of the final tubes and the plate coil of the driver stage so that no transmission line is needed between the two stages. The extent of the shielding may be seen in the photographs.

The driver and final tanks should be pretuned with a grid-dipper before application of excitation. A field strength meter is very useful for loading the final into the antenna. I connect my field strength meter to my two meter beam while operating on six meters.

The field strength meter is set to read 100 micro-amperes, while running the Sixer barefoot. It will then kick-up to about 300 micro-amperes using the linear, representing a power gain of 9 to 1.

Any low output 6 meter rig will drive this linear, but if your rig has an output much over 10 watts, you may find it necessary to eliminate the 837 driver stage. Even a Sixer will overdrive this amplifier. I detune the driver tank slightly to keep the current in the final down.

Be careful not to modulate this rig too heavily as it will splatter. The cathode meter, in the final, can twitch a little but the Heath Power Meter I used must remain pretty steady or overmodulation is indicated. If I adhere to this rule, I get good signal reports from fellow amateurs.

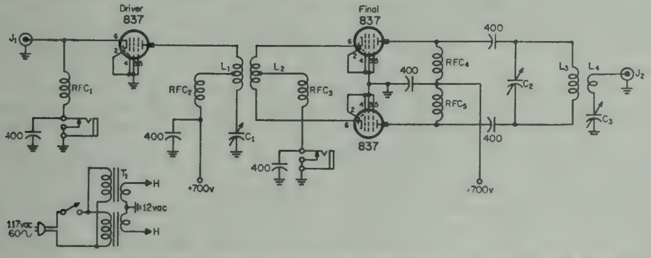


Fig. 1—Circuit of the 6 meter linear amplifier that may be driven by the Heath Sixer.

C_1, C_2—7 plate band set capacitors from BC-375 tuning units.
T_1, T_2—See Text.
C_3—100 mmf double spaced.
J_1, J_2—SO-239 connectors

L_1—6¾t #12 E., c.t., 1½" long, 1¼" diam.
L_2—6t #16 rayon covered, c.t., 1½" l., 1¼" d.
L_3—3½t #12 E., 1½" long, 1¼" diam.
L_4—2t #16 rayon covered, 1½" long, 1" diam.
RFC_1, RFC_2, RFC_3, RFC_4, RFC_5—1 Microhenry, 300 ma.

2 Meter "Oscar" Beacon

The transmitter consists of a complete two meter transmitter packaged in a balsa wood box measuring 1" × 2⅜" × 4½" and weighing 3.5 ounces, complete with batteries and antenna. Entertainment type transistors are used to generate a power output of 20 milliwatts (0.02 watts). Radiation is accomplished by means of a horizontally polarized dipole measuring 38 inches tip-to-tip. Environmental testing has shown it to perform satisfactorily

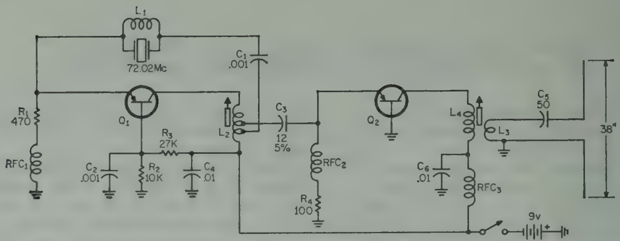


Fig. 1—Schematic diagram of a practice OSCAR beacon. The 20 milliwatt 2 meter transmitter uses 5th overtone crystals at 72 mc and is powered by a single 9 volt mercury battery. Capacitors C_3 and C_5 are silver mica; all others are disc ceramic.

L_1—19 t. #24 e. on 1 meg, 1 w. resistor.
L_2—9½ t. #24 e. on 5/16" dia. slug tuned printed ckt. form tap 3¾ t. and 2½ t. from cold end.
L_3—1¾ t. #22 e. on cold end of L_4.
L_4—6¼ t. #24 e. spaced approximately 1/16", on 5/16" dia. slug tuned form. Remove slug, spread or compress turns for maximum output.
Q_1, Q_2—T 1693, T 1858 or 2N1745 (Philco).

between −30 and +130°F. The oscillator is made intentionally temperature sensitive and shifts higher in frequency with decreasing temperature at a rate of approximately 100 cycles per degree F.

The schematic diagram for the beacon transmitter is shown in fig. 1. It consists of a 72 mc fifth-overtone oscillator driving a buffer-doubler to 144 mc.

The oscillator is a Philco 2N1745 MADT (Micro Alloy Diffused Transistor) connected in a common base configuration. Forward bias is applied to the base at the junction of R_2 and R_3. Resistor R_1 provides d.c. degeneration to stabilize the stage. Capacitors C_2 and C_4 bypass the base and collector circuit. The output coil is resonant at the fifth-overtone frequency in conjunction with the collector-base capacitance. This not only makes the output impedance quite high but also makes the stage temperature sensitive. Feedback is permitted between a tap on the coil and the emitter through the quartz crystal. The capacitance of the crystal must be neutralized to prevent feedback of an incorrect frequency through the capacitance of the plates. Coil L_1 is resonant approximately 5% higher than the fifth-overtone frequency. Off resonance it appears to be an open circuit. At resonance the r.f. sees a low impedance and a feedback path is created. Although a 72.02 mc crystal is used, the circuit pulls the frequency several kc and the nominal frequency is approximately 144.05 mc at room temperature. The oscillator has been designed to operate at a battery end-life voltage of 3 volts. At this point the power output is less than one milliwatt.

The driving power from the oscillator stage is fed to the buffer/doubler from an appropriate tap on the oscillator coil. This stage operates in the common base configuration and receives its forward bias due to the rectification in the base-emitter diode. The operation is much the same as grid current bias in a vacuum tube circuit. The positive r.f. cycles cause the stage to draw current. Since there is a good deal of clipping, and the stage is operated class B, the output is rich in harmonics. The tank circuit, consisting of L_4 and the output capacitance of transistor Q_2, is resonated at 144 mc. Chokes RFC_3 and RFC_2 isolate the stage from the remainder of the circuitry. Resistor R_4 determines the operating point for the doubler and also serves to limit the stage dissipation.

R.f. output from the doubler is coupled to the dipole antenna through link L_3. Capacitor C_5 cancels out the link reactance. A nine-volt transistor radio battery supplies power for both stages. The total current consumption is 10 milliamperes or 90 milliwatts power drawn from the battery. Thus the efficiency overall is between 20 and 25% which is about "par" for the course.

The transistors used in the transmitter are entertainment types (used in Philco portable television and f.m. receivers) and are available for approximately $3.00 each. Their dissipation is 75 milliwatts which is more than adequate for this application. For slightly more power output, the less efficient RCA 2N384 type can be used. It may be possible to obtain 30 to 40 milliwatts from two 2N384's in this circuit.

The exact inductance and number of turns for the chokes is not important. What is important is that they be self resonant at 144 mc. Construct the chokes by winding a ½ watt resistor full of #36 enamel wire. When they are cemented and dry, grasp one end and touch the other end to a grid-dipper coil terminal. Adjust the frequency of the dipper until the meter reads the highest. This is the self-resonant frequency of the choke. If the frequency is not within 10% of 144 mc. remove or add turns as necessary.

The adjustment technique for the neutralizing coil is similar. Start by winding a full solenoid of #26 wire on a 1 megohm, one-watt resistor. Clip the leads to ½ inch or so and connect them directly to the pins of the crystal (don't use too much heat). Measure the resonant frequency of this combination with a grid-dip meter. If it is low (which is likely) remove turns until the target frequency is reached. Do not confuse the dip and sharp rise at the crystal frequency with the higher frequency dip caused by resonance of the neutralizing coil.

The oscillator should be adjusted first by measuring the voltage developed across R_4. With a full 9 volt source (fresh battery), the voltage will be approximately 0.5 volts, indicating a current flow of 5 ma in the doubler stage. Next adjust coil L_4 for maximum power output with a grid-dipper. A Millen dipper will read approximately 0.2 with 20 mw output. To increase the stage efficiency, the slug has been removed. Maximum power output is obtained by spreading or compressing turns.

The final tuning of the transmitter should be done by observing a field strength meter, with the beacon antenna in a clear space, free from nearby wire or obstructions.

The transmitter could also be located at a high spot for a fixed signal source. Such a signal would be useful for antenna testing and weak signal converter adjustments. A similar unit, constructed by the author and located at Running Springs, California, was consistently heard in San Diego (approximately 120 miles to the south) with an S7 signal strength. The transmitter elevation was 6,400 feet above sea level.

The transmitter could also be used to generate a weak signal on 420 mc, by replacing C_5 with a back biased Pacific Semiconductors High-Q Varicap diode and cutting the antenna down to 12.5 inches.

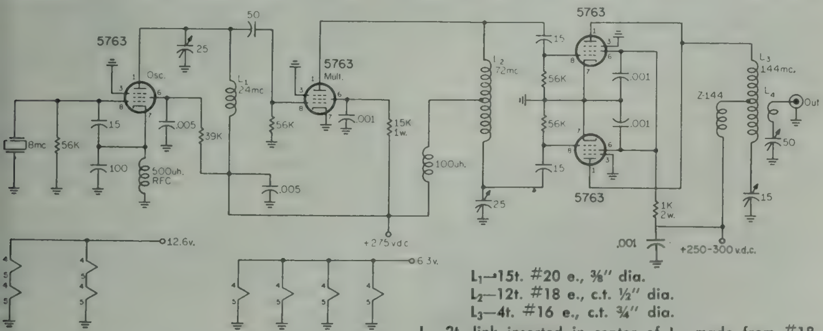
The transmitter was built on an epoxy circuit board but there is nothing magic about this technique and any suitable insulating material should suit the purpose. The coil taps listed in the parts breakdown fan out directly above the four terminals on the etched circuit coil form.

Transistor sockets were used so that the most efficient type of transistors could be determined without a lot of soldering and unsoldering. These need not be incorporated however, if the same type of transistors are used.

A balsa wood box was constructed to contain the board and keep the elements off the circuitry. The dipole antenna, consisting of two 18½ inch lengths of wire, was secured to the top by cutting a groove in the wood. The antenna wire, with right angle bends at the center, were cemented into these grooves, then covered with another piece of balsa for additional rigidity. The spacing between the two terminals is one inch. Capacitor C_5, and the lead from coil L_3, were soldered to the ends of the dipole, where they enter the case. A $^6/_{32}$ bolt projects through the top, between the two antenna terminals. A small hole drilled in this bolt accepts a length of wire for suspending the rig.

Simple 2 Meter Transmitter

The circuit shown will drive an 829B, 5894, pair f 6146s, 4X150 or similar tube to full output on 144 nc. Used by itself as a transmitter, it will deliver comparable power to the somewhat ancient SCR-522 or similar surplus transmitter. Four 5763s are employed thus permitting filament hookup for 12 volt mobile use. The tubes are low priced and readily available. The output stage is connected in push-push, eliminating



L_1—15t. #20 e., ⅜″ dia.
L_2—12t. #18 e., c.t. ½″ dia.
L_3—4t. #16 e., c.t. ¾″ dia.
L_4—2t. link inserted in center of L_3, made from #18

Fig. 1—W8HHS's 2 meter transmitter using four 5763s. Power supply requirements: 250-300 v.d.c. at 150 ma.; 6.3 v. at 3 amps. or 12 v. at 1.5 amps. All capacitors are in mmf unless otherwise stated and all resistors are ½ watt.

neutralizing problems and permitting comparable efficiency to a conventional straight-through amplifier. Any modulator capable of delivering 12-18 watts of audio will fully modulate this rig. (Push-pull 6AQ5s will do the job). The modulator will "look into" 2,800 ohms load impedance.

The usual TVI precautions should be observed with this rig as is the case in usual v.h.f. practice. All capacitors should be disc ceramic; short, direct leads should be employed. Adjust all tuned circuits for maximum output. If used as an exciter, L_4 can be varied for proper grid current to the final stage. This push-push doubler rig should make possible many DX contacts or drive that high-powered final with excitation to spare.

20 Watts on 2

The transmitter has a 6360 in the final which operates quite efficiently at two meters with a nominal input of 20 watts. No layout or construction details are presented, as the average v.h.f. enthusiast should already be well aware of the importance of shortest possible leads on everything — including bypass capacitors — in v.h.f. construction. Reminder: at two meters a .001 mf disc ceramic capacitor with a total lead length of ¾" becomes an *all*-pass capacitor in a number of applications. Pay particular attention to the lead length from the plate of the 5763 to L_3.

Minimize the coupling between L_3 and L_4.

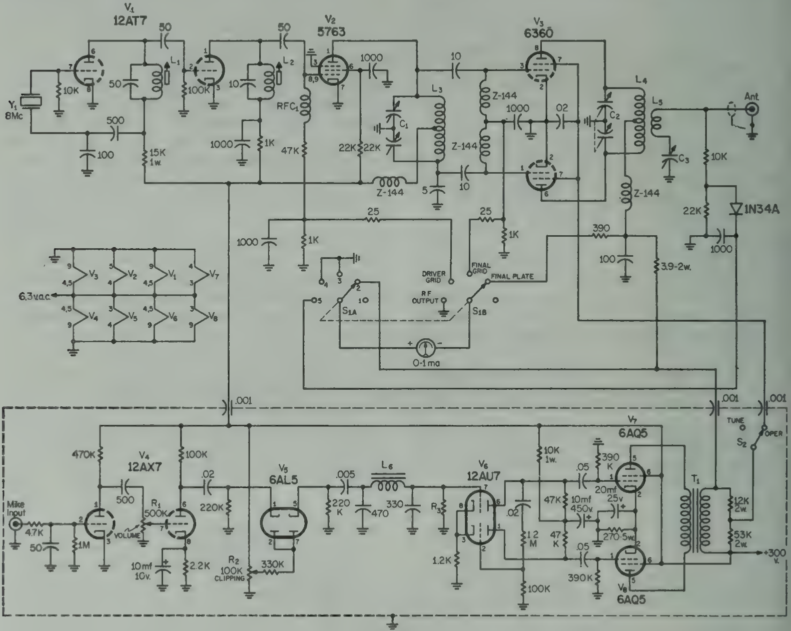


Fig. 1—Schematic diagrams of the "Lancer" two meter transmitter, nominally rated at 20 watts input to a self-neutralized 6360. All capacitors greater than one are in mmf and less than one in mf. All resistors are ½ watt unless otherwise noted.

$C_{1,2}$—11 mmf per section miniature butterfly. E. F. Johnson 160-211.
C_3—20 mmf miniature variable. E. F. Johnson 160-110.
L_1—0.90-1.6 µh slug-tuned coil, wound to resonate at 24 mc. J. W. Miller 4403.
L_2—0.40-0.65 µh slug-tuned coil, wound to resonate at 72 mc. J. W. Miller 4303.
$L_{3,4}$—4 t. #14 c.t., ½" i.d., spaced to ⅞" long. Resonate at 144 mc.
L_5—2 t. #14 wound around center of L_4. See text.
L_5—2 t. #14 wound around center of L_4. See text.
L_6—20 henries, 900 ohms. Stancor C-1515.
RFC_1—2.5 µh r.f. choke. National R-100S.
S_1—2 pole, 5 position rotary switch.
S_2—S.p.s.t. slide switch.
T_1—Modulation transformer, tapped secondary, primary 10,000 ohms plate-to-plate. Thordarson 21M68.
Y_1—8 mc third overtone crystal.

lthough the 6360 is self-neutralized at this freency, too much coupling could cause selfcillation of the final. A tin shield placed across e 6360 socket soldered to the cathode tabs of e socket and well grounded will help isolate e grid and plate circuits.

The oscillator, too, deserves some discussion. s shown in fig. 1, the oscillator is an overtone. ne crystal oscillates on its third harmonic, *not* fundamental. If 8 mc r.f. is present, the oscilor is not properly adjusted. When functioning rrectly, the lowest r.f. present anywhere in the ansmitter will be 24 mc. Oscillation takes place th L_1 resonated *slightly above* the third overne of the crystal. If, on the other hand, your vorite oscillator is a Colpits, try replacing the AT7 with a 6U8A and use the pentode section the oscillator and the triode section as the ultiplier.

Coil L_5 is coupled to L_4 for proper plate current with C_3 adjusted for maximum plate current while maintaining resonance under load. Be sure to keep the modulator out of r.f. fields. The modulator is shielded in tin with all leads in and out bypassed with .001 mf disc ceramics. On the modulator, R_2 controls the clipped level output of the 6AL5; the higher the level, the greater the percentage of modulation. Obviously, it should be set for less than 100%. It should not be a readily available control. Set it once and forget it. R_1 is the simple volume control and can be brought out to the front panel for accessibility. If you wish, the clipper can be eliminated by simply connecting C_4 directly to the grid of V_6 leaving out everything except R_3. Position one of S_1 merely connects the 0-1 ma meter on the transmitter to the receiving S meter and could be ignored.

2 Meter Kilowatt

The power supply and r.f. components are ntained all in the same cabinet with all conols brought out to the front panel. The plate, reen, and grid of the 4X250B's are metered th a 0-750 ma. meter in the plate, and a 20 ma. eter being switched between the control grid d the screen grid. The tuned lines can be adsted for length; the loading capacitor, plate pacitor, and grid variable are all tunable from e panel. The bias control is also accessable. arious switching for the filaments, high voltage, w voltage, etc., is also controlled from the ont panel.

The plate tank and tube compartment was made from a 7 × 15 × 6″ aluminum box. To the base of this was added two 7 × 7 × 2″ aluminum chassis bolted on the bottom to form the grid compartment and a box for some of the power supply components. The grid compartment must have a bottom plate fastened to it, so it becomes a pressurized section onto which a blower of sufficient square-foot-per-minute can be mounted to keep the tubes cool.

The two tube sockets for the 4X250B's are mounted on one of the small 7 × 7 × 2″ chassis spaced ⅜″ apart arranged to clear the back of the plate line box. The plate tank is constructed by using two pieces of ½″ copper water pipe

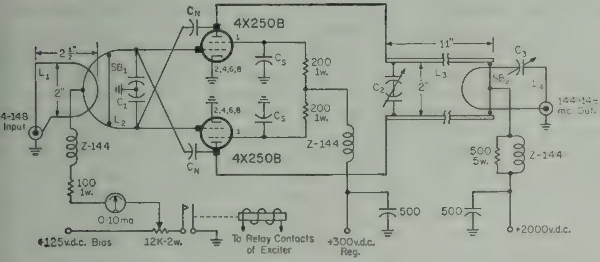


Fig. 1 — Schematic diagram of the described push-pull 1000 watt class AB$_1$ linear amplifier for 144 mc. This straight-forward linear can be excited with 10 to 15 watts of c.w., a.m., or s.s.b.

$_2$—Split-stator single rotor (single stator each side with approximately .2″ gap).

—15 mmf, double spaced variable capacitor.

—Crossed 1″ grid leads constructed of #18 e. through chassis near far side of each tube. See text for neutralization info.

—Part of 4X250B tube socket.

—2½″ long hairpin loop of #14 spaced ⅝ to ¾″ from L$_2$ and rigidly fastened.

L$_2$—4″ hairpin loop of #14, 1½″ wide.

L$_3$—Tuned lines constructed of two 11″ sections of ½″ copper tubing spaced 2″ apart, shorted with variable shorting bar as detailed in fig. 2.

SB$_1$—Piece of #14 copper wire used as shorting bar across L$_2$ so that C$_1$, half meshed, will tune tank to approximately 146 mc.

SB$_2$—Adjustable threaded shorting bar for L$_3$. See plate tank detail, fig. 2.

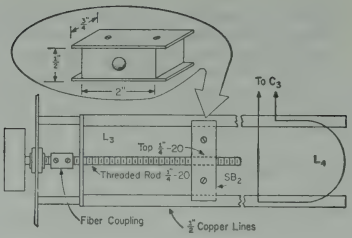


Fig. 2—Diagram of the tuned lines in the tank circuit of the 1000 watt linear amplifier for 144 mc. Note construction of the shorting bar, SB_2. Length of tuned lines is 11 inches.

11" long. The shorting bar is formed by a ¾" bronze rod with two sides filed flat to conform with the diameter of the ½" copper plate lines. By using some silver nitrate powder, the builder can silver plate all of the copper parts in the tank circuit. The copper parts must be thoroughly cleaned and brightened by hard rubbing with steel wool. The silver nitrate powder is then rubbed onto the part to be silver plated. This silver nitrate is used by electrical firms to silver plate buss bars before silver soldering and is available under the trade name, *Kool Amp.*

The grid circuit is made from #14 wire bent into the proper shape as illustrated. The grid coil L_2 is mounted right to the grid pins of the tube sockets. C_1 is mounted on the front of the compartment and controlled from the front panel by a 5" length of ¼" rod connected to the shaft of C_1. The grid link L_1 is connected to the coax fitting on the back panel, routed over the top of L_2 and grounded to the chassis at a point in the center of the two tube sockets.

Neutralization of the amplifier is very easy by using some of the non-capacitance feed-thru insulators beside each tube socket and attaching the crossed grid leads to the bottom side of the feed-thru. On the top side of the chassis, a one inch length of #18 en. wire can be attached to the feed-thru. By moving these leads closer and further apart from the 4X250B's, proper neutralization of the amplifier is obtained.

Check all of the tuned circuits with a good grid dip meter to assure that all the coils and tuned lines are on the proper frequency and can all be tuned with adjustment of the correct capacitors in each circuit. After frequency is obtained and the amplifier is ready to fire, the first thing to check is to make sure the blower and the filaments are coming on at the same time. *Never operate the filaments without the blower running!*

Neutralization is to be accomplished next. By using the r.f. probe in the v.t.v.m., connect the probe to the center conductor of the coaxial output connector and ground the shield. With drive from the exciter applied, *B-plus off,* adjust the two stubs of #18 enameled wire along side of each tube for minimum reading on the v.t.v.m. B-plus and bias can now be applied and adjust the voltages to these values: plate voltage, 2000 v.d.c.; screen grid voltage, 300 v.d.c.; control grid voltage adjusted so that the plate current draws 200 ma. with no drive applied; heater voltage, 6 v.a.c., 2.1 amp.

Apply drive from the exciter again and load the amplifier to the antenna system. You should now be able to load the plate to 400 ma. with no trouble with proper adjustment of the grid tank and plate lines. At this point the input will be 800 watts with a steady carrier (this will be more or less depending on the antenna system and the efficiency of the plate lines). One thing to remember about an amplifier of this type is that most of the problems encountered with parasitic oscillations and unstable operation are usually developed with excessive grid current (control grid and screen grid) which become very harmful to the tubes under prolonged operation.

Plate loading should be fairly heavy with a point of good output obtained while maintaining a minimum of screen current. The lower voltage and higher current is much more effective than low current and higher voltage. The screen dissipation is 12 watts per tube and this is one point that should be observed very closely. If the screen dissipation rating is exceeded, the tubes will be very short-lived and will die a horrible death.

2 Meter Transceiver

The complete unit is constructed upon a 12 × 3 × 8" chassis. All control locations are readily apparent from the photographs. The tube sockets are mounted on the divider strips, thus providing effective shielding of r.f. components. Almost all components may be mounted on the sub-assemblies while they are out of the chassis, making construction simple. Feed-thrus are provided for final r.f. grid drive and modulation input. The r.f. output coil is terminated in a b.n.c. connector which in turn goes to the TRANSMIT-RECEIVE relay. Receiver construction is not critical, although all leads should be kept as short as possible. Due to stray capacitance and construction techniques, the values of inductance and capacitance for the receiver may not be identical to those noted in

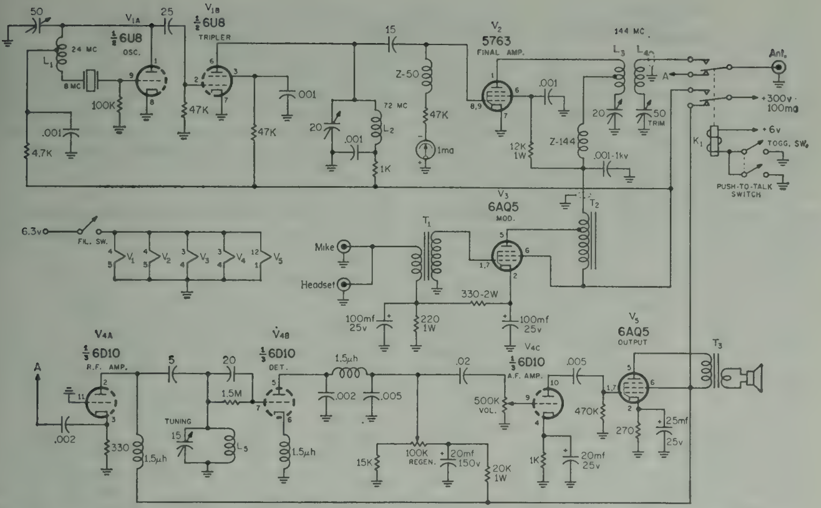


Fig. 1—Schematic diagram of the "compactron" to meter transceiver capable of 3 watts output and utilizing a superregenerative receiver. Standard 8 mc crystals are used.

L₁—15t. #20 tinned ½" dia. ⅞" long tapped 4t from crystal end. B&W 3003.
L₂—5¾t. #16 tinned 7/16" dia. ⅝" long.
L₃—4t. #16 tinned ½" dia. center tapped.
L₄—1t. hook-up wire 1" dia. link on center of L₃.
L₅—2t. #16 tinned ½" dia.

T₁—Input transformer, single button, carbon hi-gain. Triad A-5X.
T₂—Modulation transformer, 5K-6.75K. Triad M4Z.
T₃—Output transformer. 5K to voice coil.
K₁—D.p.d.t. relay, v.d.c. coil. Potter & Brumfield KL11D.

the schematic. However, with the aid of a grid dip meter a bandwidth of approximately 140-150 mc, should be easily attained.

Tuning of the r.f. section is quite straightforward. Disconnect B+ and screen voltages from the 5763 and insert an 8 mc crystal in the socket. Adjust the osc. plate tuning capacitor for resonance at approximately 24 mc, which is evident by a very pronounced dip in plate curent. Plate current runs about 20 ma at resonance. Now adjust the tripler plate circuit for maximum grid current to the 5763 stage. Grid current with the transmitter fully loaded should run about 1 ma. Check with a grid dip meter to insure that the tripler is operating at approximately 72 mc. Now apply plate and screen voltages to the 5763. With the aid of a grid dip of field strength meter, tune the final for maximum output at 144 mc with a dummy load consisting of a No. 47 pilot lamp across the antenna terminal. Adjust final plate and the antenna loading condenser for maximum brightness of the lamp. Now with a meter in the + circuit, *very quickly* pull the crystal and see if the dummy load goes out indicating the circuit is crystal controlled. If it does not go out, the 5763 stage needs neutralizing, which is usually not the case. However, if this situation exists, a small value of capacitance in the screen grid of the 5763 will cure the problem. A value of 312-mmf should do the trick. Now plug in the headset or mike and speak at a normal level. The lamp should increase in brightness and the plate meter should "kick" upward about 20 ma on voice peaks. Total transmitter plate current should run about 50 ma with the final fully loaded. With the modulator in the circuit, the plate current will be approximately 100 ma.

Adjustment of the receiver is very simple. The detector circuit should be adjusted so the bandwidth is approximately 140-150 mc. Spreading or compressing the tank coil should bring the circuit into the two meter band. Maximum sensitivity seems to be obtained when the REGEN pot is set at the point where the receiver just breaks into oscillation. However, on strong signals, advancing the pot will allow more volume while still retaining the inherent a.v.c. action of the superregen detector. It was also found that c.w. signals were received very well with the REGEN control turned all the way counter-clockwise. With a 19-inch whip mounted on the rain-gutter of the car, no apparent change in the oscillating point of the detector was noticed, due to the antenna whipping back and forth.

220 mc Transmitter/Exciter

Low Power for 220: Shown in fig. 1 is a nifty 1¼ meter transmitter-exciter which uses 55 mc third overtone crystals (available from International Crystal for $4.40) in the 6J6 oscillator-doubler, doubles again in a 6J6 driver, and runs straight-through on 220 mc in the final. Modulation can be added with a 6AQ5-6AQ5 type configuration. The entire unit can be constructed easily enough in a 2 × 10″ chassis. Remember to keep all wires as short as possible, using feedthru capacitors where indicated. Links L_7 and L_8 should not be fixed, since coupling here is quite critical and coils may need adjustment. Limit oscillator voltage to 150 v.d.c. Grid current corresponds as follows with plate voltage: 150 v., 1.1 ma. on 6360, 20 ma. on 6J6; 175 v., 1.5 ma. on 6360, 25 ma. on 6J6; 200 v., 2.0 ma. on 6360, 30 ma. on 6J6. A suitable dummy load for tune-up can be made from two 47 bulbs in series.

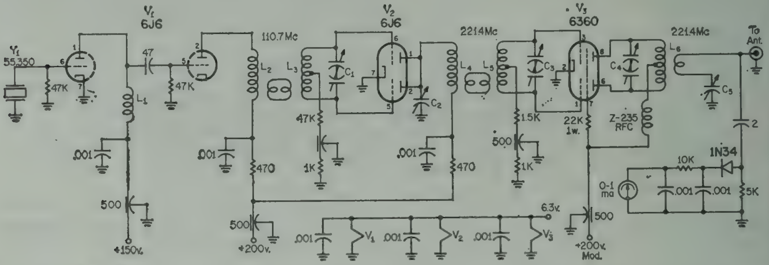


Fig. 1—Simple 220 mc transmitter-exciter employing inexpensive tubes. Doubling action in the oscillator and driver permits straight-through operation of the final. Links L_7 and L_8 are quite critical and should be constructed so that adjustment in coupling can be made. All capacitors are in mmf and all resistors are ½ watt unless otherwise stated.

$C_{1,3,4}$—14 mmf butterfly. Hammarlund type BFC-12.
$C_{2,5}$—16 or 22 mmf. Hammarlund type MAC-15 or MAC-20. C_2 may have to be cut down.
L_1—10t. #24e. close wound on ⅜″ iron core slug-tuned form.
L_2—6 t. #20 e. close wound on ⅜″ iron core slug-tuned form. Link: 2 t. hookup wire at cold end.
L_3—8 t. #18 e. air wound ⅜″ dia. Link: 1 t. hookup wire at cold end.
L_4—1 t. #18 e. air wound ⅜″ dia. Link: 1 t. #18 ⅜″ dia.
L_5—2 t. #18 e. air wound ⅜″ dia. Link: 1 t. #18 e. ⅜″ dia.
L_6—2 t. #16 e. air wound ½″ dia. Link: 2 t. #18 e. ⅜″ dia.
Y_1—55.350 mc third overtone crystal.

60 Watts on 220

It is built on a 5 × 13 × 3 inch aluminum chassis. The 4¾ × 13 inch panel is secured to the chassis with ¾″ angle stock. Originally it was planned to shield the entire enclosure, but this was found to be unnecessary. In some areas TVI may be more of a problem and this may be advisable.

All controls except L_1 are mounted on the front panel as shown in the photos. Meters may be mounted in the chassis if desired. Wiring is done in shielded lead as a TVI precaution. The antenna relay is mounted in the rear, but may be located externally if desired. The final stage is mounted horizontally on a 4¾ inch square aluminum bracket. The 24G socket is mounted on top of the chassis on ½″ standoffs so the filament (cathode) return will be above the chassis. If shielding is decided upon it will be necessary to drill ventillation holes in the front panel and on the top and rear of the final tube.

The 5894 socket is positioned with the cathode pin closest to the panel. One end of a ½″ copper strap is screwed to the bracket and the other end is soldered to the cathode lug using the shortest possible lead. The neutralizing capacitor is mounted between the screen lug and a soldering lug bolted to the bracket. The 200 ohm screen resistor and the 5000 ohm grid resistor with its bypass are also mounted on the bracket, their leads routed under the chassis.

Since rather tight coupling is required between L_4 and L_5, a piece of 5 mil Mylar is slid between them to keep h.v. off the final grid. A good tube was ruined when a transient arced over, so it is advisable to take this pre-

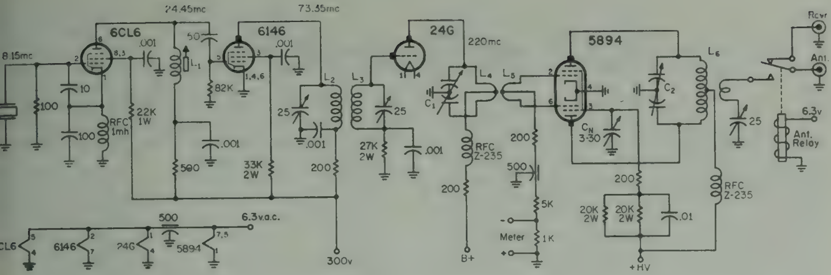


Fig. 1—Circuit of the 220 mc transmitter. The 25 mmf variables are of the APC type. All resistors are ½ watt, all capacitors less than one are in mf and greater than one in mmf unless otherwise noted.

C_1, C_2—1.5-5.0 mmf butterfly. Cardwell PL-6076.
L_1—12t #28E on ⅜" iron slug tuned form.
L_2—3t of B&W 3007.
L_3—4t of B&W 3007 spaced ½" from L_2.
L_4—Hairpin loop of #14, 2" long, ½" wide.
L_5—See text.
L_6—2t #14, 13/16" i.d., ⅜" wide with a 1 turn link, ¾" d. of #18 inserted in L_6.

caution. The final grid coil, L_5, consists of a piece of #14 copper wire connecting the two grids with a ½ × ½ inch "bump" in the middle. This should be resonated at 22 mc with a grid dip meter before L_4 is secured in place. It will be necessary to have the final tube wired and its filament lit to do this, otherwise it may be pruned for maximum grid current after the rig is completed and the driver stage is operating.

Tuneup

Tuneup is very simple. The neutralizing capacitor, C_N, should be adjusted for minimum effect on the grid current (with no final plate voltage) when the final capacitor is tuned through resonance. Some additional adjustment may be required after the rig is placed in operation, but it is not extremely critical. When the rig is operating properly into a load, there should be a slight rise in grid current when the final is resonated. Tuneup should be carried out with about 250 volts throughout until proper operation is assured. The final may be operated over a rather wide range of plate voltages, depending on what's available in the way of a power supply. About 400 volts will do nicely. The driver is run at the same potential as the final, thus assuring adequate drive at the selected level. It should be possible to obtain 4 ma of grid current with 400 volts on the driver and final.

Keying is possible in a number of ways. Perhaps the best would be to key the cathode of the 6146 and use fixed bias on the 24G and 5894 grids.

144/435 mc Tripler

If you are planning to run the tripler directly into an amplifier, forget about the final tuned circuit and run the varactor directly to the amplifier tube's grid. The tuned circuit on the plate side of the amplifier will eliminate the unwanted subharmonics present.

Tune-up is not complicated, although it can get a little exasperating, since all controls seem to interact. The important thing is to make sure you are looking at power output on 432 mc. A coaxial filter before the watt meter or whatever you use to measure power out would be a good idea. Then keep tuning everything until you have achieved maximum output.

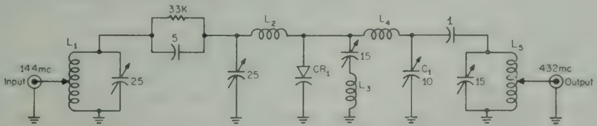


Fig. 1—144 to 432 mc varactor tripler.

C_1—1-10 mmf glass piston trimmer.
CR_1—Varactor diode.
L_1—4 t. #18 tinned ¼" dia. ½" l. Tap at 1½ t. from cold end.
L_2—4 t. #18 tinned ¼" dia. ½" l.
L_3—3 t. #14 tinned 3/16" dia. ⅜" l.
L_4—2 t. ⅛" wide copper strap ⅜" dia. ½" l.
L_5—1½" long copper strap across C_1.

432 mc Transmitter

This version was built on a 4½″ × 10½″ × 2″ junk chassis, but anything that offers enough space should be suitable. Layout the chassis to provide short r.f. leads, particularly in the 432 mc stage. Complete shielding of the 432 mc circuits is desirable to prevent radiation losses. It's also a good idea to use feedthrough bypass capacitors on all entering power leads to prevent r.f. being lost due to radiation from the wires. Resistors R_4, R_6, and R_7 are placed outside the chassis to permit easy measurement of the voltages across them.

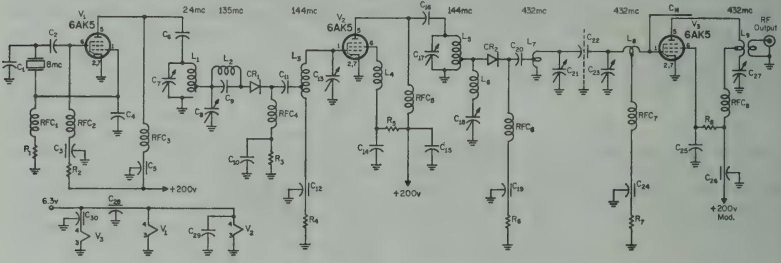
Shields are used across the two amplifier sockets, isolating pin numbers 1 and 2. Each shield is grounded as close as possible on both sides of the socket, and pins 2, 3, 7, and the center post are soldered directly to the shield.

The r.f. chokes used for shunt feed of the first two stages (RFC_3 and RFC_5) should be high *Q* and some experimentation with different chokes may help bring up the drive. Substitution of a 2.5 mh choke for RFC_3 resulted in substantially reduced output as measured across R_4. The choke finally selected was a 3 pie job having an inductance of about 50 µh.

Notice the inductance values used for RFC_7 and RFC_8. It is always good practice to use vastly different inductance values for grid and plate r.f. chokes in series tuned (or push-pull) amplifiers because it eliminates any possibility of tuned-plate tuned-grid oscillation at the r.f. choke resonant frequency.

Adjustment

First step in tuning up is to check the various tuned circuits with a grid-dip meter. After setting to the approximate frequencies indicated in fig. 1, apply 200 volts to the oscillator only and check with your receiver to make sure it is crystal controlled at 8 mc. Then tune in the 2 meter harmonic and adjust C_7, C_8, and C_{13} for maximum S-meter reading. You should now have some grid current in the second stage as measured



Circuit of the 3 tube 432 mc exciter-transmitter capable of a quarter watt output. All resistors are ½ watt. Resistors R_4-R_6 and R_7 are mounted external to the shielding for convenience in testing.

C_1—10 mmf ceramic.
C_2, C_6—1800 mmf, ceramic.
C_3, C_5, C_{12}, C_{19}, C_{24}, C_{26}, C_{28}, C_{30}—.001 mf ceramic feedthrough.
C_4—8 mmf ceramic.
C_7—50 mmf APC.
C_8—20 mmf APC.
C_9—22 mmf ceramic.
C_{10}, C_{14}, C_{15}—500 mmf button.
C_{11}, C_{16}, C_{20}, C_{29}—56 mmf ceramic.
C_{13}, C_{17}, C_{21}, C_{23}, C_{27}—2-9 mmf Johnson miniature.
C_{18}—0.5-10 mmf piston.
C_{22}—1 mmf ceramic.
C_{25}—10 mmf ceramic.
C_n—Neutralizing capacitor. See Text.
CR_1—Three 1N270's in parallel.
CR_2—Two DR-303's in parallel.
L_1—15 turns #18 e. ½″ dia. form ¾″ long. Tap six turns from ground.
L_2—3 t. #22 e. ¼″ dia. air wound.
L_3—4 t. #18 e. 5/16″ dia., ⅜″ long, tap 1 turn from top.
L_4—2¼″ of #18 e. See Text.
L_5—3½ t. #18 e. 5/16″ dia., 5/16″ long. Tap one turn from ground.
L_6—1½″ of #18 e. bent into U shape.
L_7—1¾″ of #16 e. bent into U shape. Tap ½″ from top.
L_8—1¾″ of #16 e. bent into semicircle. Tap ½″ from C_{23}.
L_9—2¾″ of #16 e. bent into U shape. Tap 1½″ from plate. Output link: 1¼″ #18 plastic covered, U shaped.
R_1—47K.
R_2, R_5, R_8—15K.
R_3—33K; See Text.
R_4—22K.
R_6—470K; See Text.
R_7—33K.
RFC_1, RFC_2—100 µh video peaking coil.
RFC_3—50 µh, 3 pie choke.
RFC_4, RFC_5—18 t. #20 e. ¼″ dia. ¾″ long, air wound.
RFC_6—5 t. #20 e. 3/16″ dia. ¼″ long, air wound.
RFC_7—1¾″ #20 e. bent into U shape.
RFC_8—5 t. #26. e. 5/32″ dia. ¼″ long, air wound.

with a v.t.v.m. across R_4. Maximize this voltage by peaking all first multiplier adjustments (C_7, C_8, C_{13}, L_2, and R_3). There will be more than one peak on C_8, so use the setting of greatest output. Inductor L_2 is adjusted by squeezing or spreading the turns.

When convinced you have the maximum attainable voltage across R_4 (you should end up with more than 8 volts), you're ready to neutralize the second stage by adjusting the screen inductance. This inductor, L_4, is an L-shaped piece of #18 solid wire about 2¼" long running between the screen (pin 6) and C_{14}. It is adjusted by shortening a little at a time until the stage is properly neutralized. If you want a more convenient arrangement, you can use the series tuning method described in the earlier article, or substitute a slug-tuned coil for L_4. Neutralization is not critical, however. The output of CR_2 as measured across R_6 with a v.t.v.m. makes a convenient neutralizing indicator. With no plate or screen voltage on the second 6AK5 but with C_{17} tuned to resonance, this rectified r.f. voltage should be less than 0.2 volt with the stage properly neutralized.

When these adjustments are completed, plate and screen voltage may be applied to the second stage, and the 432 mc harmonic tuned in on a receiver. Components C_{21}, C_{23}, C_{17}, C_{18}, and R_8 are then tuned for maximum S-meter reading and maximum voltage across R_7. This voltage should be more than 7 volts with no B plus on the final.

The final amplifier neutralizing "capacitor" is a ½" length of #20 plastic covered hook up wire soldered to the grid (pin 1) and running under the shield over near the plate pin. The spacing is adjusted for proper neutralization. Only a very small amount of capacity is needed. For a neutralization indicator you can use a diode and meter connected to the output jack or use the time honored method of adjusting for minimum grid current "wiggle" as the plate is tuned through resonance.

With the final neutralized, screen and plate voltage may be applied and everything peaked for maximum output to the antenna or dummy load. About 1.25 watts of audio will fully modulate the final and linearity is good.

440 mc TV Transmitter

Closed-circuit amateur television systems have been sprouting up all over. However, the jump from closed-circuit experiments to on-the-air operation has been slow and in some cases imperceivable. One of the reasons for this poor progress is the lack of information on transmitting gear applicable to TV operation. The transmitter shown in fig. 1 was designed for the

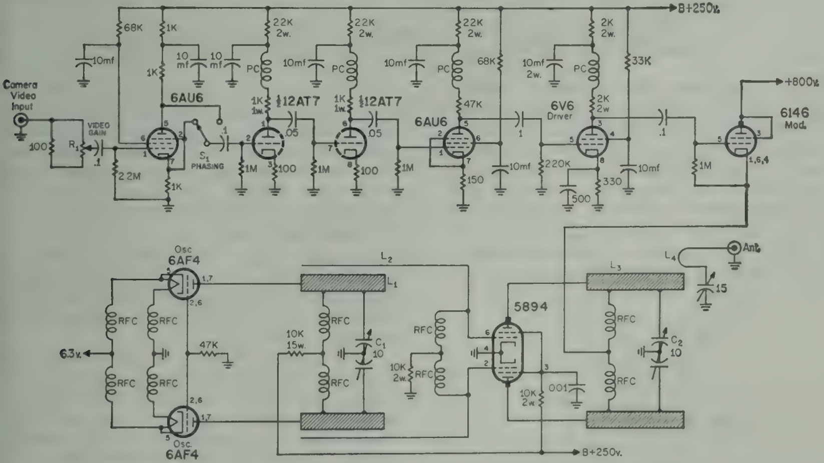


Fig. 1—Low cost, easy to build video transmitter for 440 mc band. Designed to put delinquent closed circuit systems on the air.

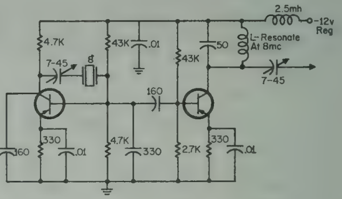
C_1, C_2—10 mmf Butterfly Variable Capacitor.
L_1—3½" of number 12 wire mounted on Butterfly Capacitor.
L_2—5" of number 12 wire.
L_3—3½" by ½" copper straps mounted on Butterfly Capacitor.
RFC's—16 turns of number 18 wire, 3/16" in diameter.
PC—peaking coil from old TV set.

express purpose of getting the closed-circuit TV fugitive on the air. It can be reproduced for less than the price of the surplus ART-26 TV transmitter, yet compares favorably in operation. For simplicity the circuit employs a self-excited oscillator on the 440 mc band. This type of excitation is not a bad compromise when it is realized that a TV signal is over 6 mc wide! No problems of stability have been found during on-the-air operation. However, care should be taken in determining the frequency of operation. If no other means are available, lecher wire or a slotted line may be used to determine transmitter frequency. Special notice should also be paid to the coupling between the oscillator and the 5894 amplifier. Place a 10 ma. meter in series with 10K grid resistor and adjust the spacing between the grid wires and oscillator plate lines for maximum grid current. At least 3 ma. of grid current is needed to drive the amplifier; if this value is not obtained, try pruning the grid wires. The rest of the circuit is straight-forward.

Plate modulation is achieved by varing the drop across a 6146. A plate voltage somewhat higher than normal is desired to compensate for the drop in the 6146. We use 800 volts, although the amplifier will work quite well with only 400 of plate voltage. The video amplifier has a phase inverter stage which enables the transmitter to be used with any camera and still produce a proper composition video signal. The transmitter is designed for coaxial output.

1296 mc Crystal Oscillator

Schematic diagram of K2HAC's transistorized oscillator circuit. Transistors that may be used are 2N396, 2N499, 2N247, 2N404, 2N1224, 2N1226. NPN silicons are recommended.



1296 mc Cavity Amplifier

Not only is this transmitter small and highly efficient, but it is also extremely simple to construct. As arranged and presented in fig. 1, the amplifier runs approx. 30 watts input with 5 or 6 watts of 1296 mc driver output. An APX-6 makes an ideal exciter.

The amplifier consists of a cavity made from a ¾" length of 3" diameter copper pipe (see fig. 2). Two disks 3" in diameter are cut from copper sheeting. A 1¼" hole is drilled into the center of one disk and a ¾" hole in the other. The two disks are then soldered across the top and bottom of the ¾" high pipe. The side with the larger hole will be the plate side, and the smaller, the grid side.

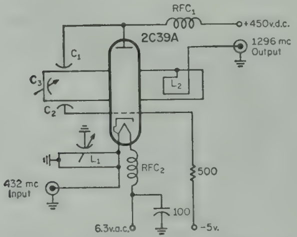


Fig. 1—Schematic diagram of K2CSM's cavity amplifier for 1296 mc. See text for data on C$_1$, C$_2$ and C$_3$.
L$_1$—1" copper strip. See text.
L$_2$—1" loop. See fig. 2.
RFC$_1$—3t. #18, ¼" dia.
RFC$_2$—6t. #18, ⅛" dia.

Two more disks are cut 2¾" in diameter. In the center of one cut a hole 1-1/16 in diameter is drilled to snuggly fit the plate of the 2C39A. The other hole should be ⅝" in diameter to accommodate the grid.

A ⅜" hole is drilled onto one side of the copper pipe for a BNC connector, onto which is soldered a 1" length of wire for an output pickup loop. On the opposite side of the pipe a ¼" hole is drilled for a screw type bushing, through which a disk type capacitor (made from a ½" circle of sheet copper) can be controlled.

The 2¾" copper disk with the larger hole is centered over the plate side with a thin sheet of teflon (containing a hole of equal size) sandwiched between it and the cavity. Same procedure is followed for the disk with the smaller

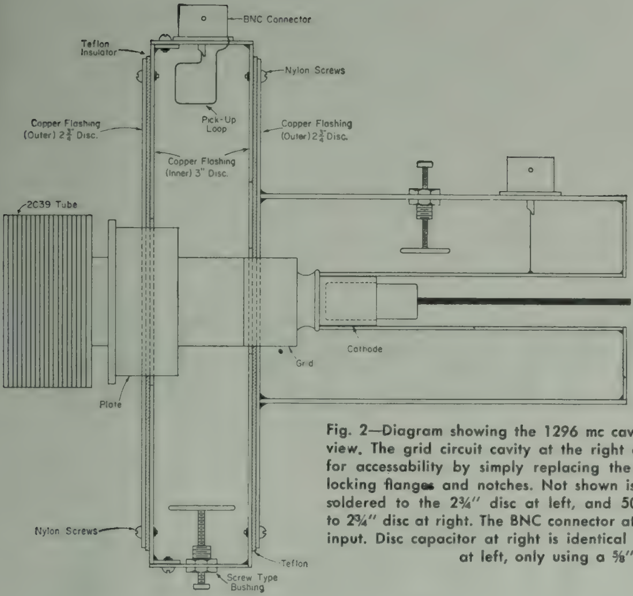


Fig. 2—Diagram showing the 1296 mc cavity amplifier in cutaway view. The grid circuit cavity at the right can be made detachable for accessability by simply replacing the solder joints with interlocking flanges and notches. Not shown is RFC_1 in the B-plus line, soldered to the 2¾" disc at left, and 500 ohm resistor soldered to 2¾" disc at right. The BNC connector at the far right is amplifier input. Disc capacitor at right is identical to plate cavity capacitor at left, only using a ⅝" plate.

hole on the other side. Both disks are held in place by means of nylon screws.

The 2C39A is fitted through the cavity as shown in the photograph. A coaxial cavity on the grid side is now constructed (this is not shown).

The input circuit cavity is made from a 1½" diameter by 2¾" long section of copper pipe. The center conductor is made from a ⅜" diameter by 2⅜" long piece of copper tubing which is soldered to the center of the 1½" disk cut from a square of sheet copper. A ⅜" hole is drilled into the center of the 1½" disk to pass a wire up the center of the copper tube to the 2C39A's heater connection. A ⅜" hole is drilled into the center of the 1½" diameter pipe ¾" (from the end which is soldered to the 1½" disk) for a BNC connector. A lead is soldered to the BNC connector and the cavity center conductor. Another hole ¼" in diameter is drilled for a screw type bushing in the 1½" pipe (in line with the first hole), 1½" from the pipe's end for a disk type capacitor (made from a ⅝" circle of copper).

With this work complete, and voltage applied as per fig. 1, she's ready to fire up on 1296 mc. The feed system's dimensions will depend on the driver and the size of the chassis the amplifier is mounted on. A little experimentation should yield the desired results.

I might also mention that a 3CX100A can be used in place of a 2C39A in this circuit with the 500 ohm resistor being replaced with a 3K resistor going directly to ground for phone operation.

VHF RECEIVERS
& CONVERTERS

6 Meter Receiver

The circuit is shown in fig. 1 and uses a single Philco 2N1728 which is sold by Lafayette Radio for only $1.23! Although the coil data is not given, an 8 turn coil on a ¼" form should hit six meters with the values shown. The link is one turn of hookup wire wound over the earphone-end of the coil, and is adjusted for best reception. The earphone is a 7,000 ohm type also sold by Lafayette, called a "super power dynamic earphone," catalog number MS-260 and $2.95. When working properly you will hear a loud hiss in the phone.

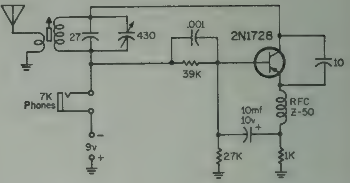


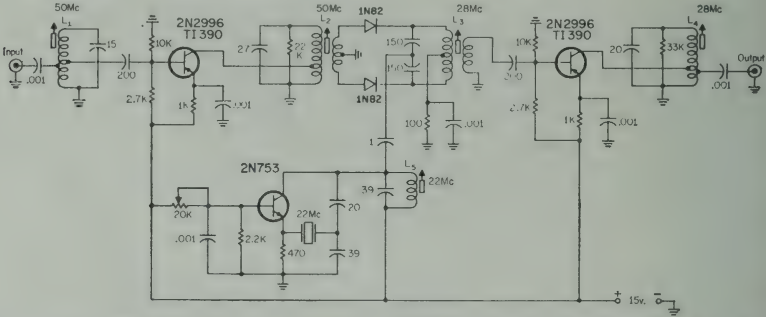
Fig. 1—Schematic of a very simple 50 mc transistorized receiver. Coil L_1 may be 8 turns of #18 e. ¼" dia. spaced to resonate the tank at 50 mc or any other suitable coil.

6 Meter Transistor Convertor

The r.f. stage has a gain of approximately 20 db and a noise figure of about 2 db. A balanced mixer was used for several reasons: 1.) Noise generated by the oscillator is cancelled out. 2.) Lower cross modulation. 3.) The 22 mc oscillator signal does not radiate as much through the antenna.

The mixer has a loss of about 3 to 6 db. The i.f. stage, having a gain of about 25 db, however, makes the overall gain of the converter between 40 and 57 db. The converter works well on as little as 6 volts and only draws 10 ma at 12 volts.

A good example of transistor performance is shown by the results of a comparison test run between my model and a converter using two 6CW4's in grounded grid. A milliwatt test oscillator was placed in a tree some 100 feet from the shack. The antenna was turned until a signal could just be heard with the transistor converter. I then switched to the 6CW4 converter and no signal was heard. The antenna was then turned until a signal could be heard. Switching back to the transistor converter produced a signal about 10 db above the noise. One last word—the converter only costs $15 and was constructed in about five hours.



L_1—11t. #22e. Taps at 2 and 3t.
L_2—Bifilar primary 7t. Tapped @ 3t. from cold end. Sec. 6t., center tap, #22e.
L_3—Bifilar primary 6t., center tapped. Sec. 6t. #22e.
L_4—15t. #22e. Tapped @ 3 and 7t.
L_5—12t. #26e.

Overload-Proof Converter For 6

The r.f. amplifier in this circuit borrows heavily from a previously published design and is known as a cathode-coupled r.f. amplifier. The high input impedance presented by the cathode follower input stage gives increased selectivity and *extremely light loading* of the antenna input circuit. Normally the cathode bias for this type circuit is developed across a resistance of approximately 100 to 470 ohms. Increasing this cathode resistance to approximately 1000 ohms lowers the mutual conductance and advantageously raises the noise figure. However, when using the high G_m Nuvistors, raising the bias does not increase the noise figure appre-

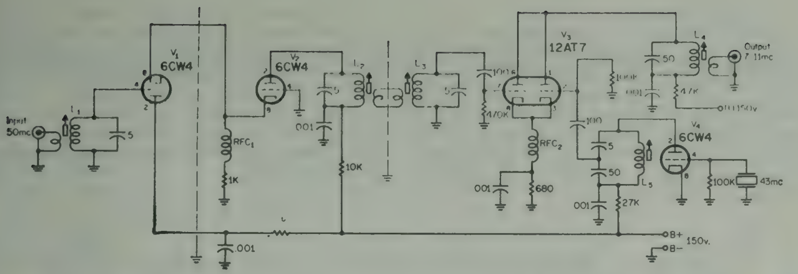


Fig. 1—Circuit of a six meter overload proof converter. All resistors are ½ watt and all capacitors are in mmf unless otherwise noted. The power requirements are 125-150 volts at 25 ma and 6.3 volts at 0.7 amps. Filament wiring is routine, therefore not shown.

L$_1$—10t #28E., close wound on ¼″ slug tuned form, CTC type LSM (white slug).
L$_2$, L$_3$—12t #28E., close wound on ¼″ slug tuned form, CTC type LSM (white slug).
L$_4$—26t #30E., close wound on ⅜″ slug tuned form, CTC type PL55 (red slug).
L$_5$—20t #28E., close wound on ¼″ slug tuned form, CTC type LSM (red slug).
RFC$_1$—2.2 microhenries or approx. 20t #24E., on ¼″ form.
RFC$_2$—3.55 microhenries or approx. 25t #24 Formvar, 5/32″ inner diam., close wound, self supporting.
Antenna Link—2t #26 insulated hook-up wire I.F.
Output Link—4t #24 insulated hook-up wire.
L$_2$-L$_3$ Link—1 turn on cold end of each coil.

ciably, but the immunity to overload and cross-modulation is increased. The plate circuit of the grounded-grid stage and the mixer grid circuit are connected to separate tuned circuits and are coupled together by a one turn link. This double tuned circuit has a unifrom frequency response over the entire band. A metal shield is inserted between the two coils to prevent i.f. feedthrough. This shield stops signals coupled through the antenna input at the i.f. frequency from entering the mixer and being amplified.

As can be seen in fig. 1, the cathode coupled mixer uses parallel connected plates and a common cathode impedance. The signal frequency is coupled to the first grid and the injection frequency is coupled to the second grid, which reduces the loading effect and increases the rejection of spurious responses. The cathode bias for the mixer is set at approximately *twice* the Class A value to obtain good overload characteristics. A high *Q* tuned circuit is used in the plate circuit of the mixer, and is resonant at the i.f. frequency of 7 mc. This circuit offers a high impedance to the i.f. voltage and a low impedance to the signal and oscillator voltages, thus providing effective filter action permitting passage only of the i.f. signal. The r.f. choke ($r.f.c._2$), in the cathode circuit presents a high impedance at the r.f. frequency and a low impedance at the i.f. frequency. The value shown in fig. 1 is optimum for an i.f. frequency of 7-11 mc. The use of a single tube type such as the Nuvistor would simplify the spare tube problem, but the 12AT7 was more readily available in quantity, so this type was used.

The mixer efficiency is extremely dependent upon the proper oscillator injection voltage. Oscillator output voltage may be adjusted while listening to signals or with a noise generator. When the correct adjustment is obtained, good gain, low noise, and lack of distortion will be clearly apparent. Too much oscillator output will result in reduced gain and increased noise, while too little output will give relatively noise-free results with not enough mixing gain. The tube noise is a function of plate current and it is a matter of measurement that the use of the cathode coupled mixer results in a better signal-to-noise ratio, *if other factors remain equal.* The increase in linearity accompanying the decrease of gain is an advantage over simple attenuation. An important result is improved linearity over a larger range. In fact, it takes a signal of several volts to overload the converter at this point.

Oscillator

The oscillator uses a third overtone crystal in parallel resonance and oscillates at 43 mc . The plate coil is parallel tuned for resonance at 43 mc. R.f. output is coupled to the mixer through a 100 mmf capacitor. A capacitive divider is used to provide a tap on the tank circuit so that the oscillator is loaded very lightly. If the tuned circuit is not tapped, the overtone crystal might show lower frequency energy (fundamental) or it might not oscillate at all.

Since this article is intended only as the presentation of our experiments, no construction details are given, although the circuit diagram is an excellent starting point for work along these lines. In our instance, it has been made to work and work well.

Some pointers are in order, however. Shielding of the r.f. stage, good grounding, and layout are of the utmost importance. All grounds for the r.f. stage must be returned to a shield partition separating the two Nuvistors in the r.f. stage. If ordinary care is taken in circuit layout, along with good shielding, a top performance converter will result that will be an object of pride.

This converter has a higher immunity to overload and cross-modulation than any other circuit configuration tried to date. Comparisons between the cascode, neutrode, and grounded-grid circuits show this cathode coupled circuitry to be superior. The overall immunity to overload, however, will be finally determined by the circuitry and quality of the receiver which is used as the tunable i.f.

1 Tube Compactron Converter For 6

This converter was constructed on a 4¼ × 2¼ × 1½" Mini-box. I actually used the Premier PMC-1016, finished in grey hammertone to make a nice appearance on the operating table. Input and output connectors, as well as power connections should be chosen to suit the needs of the constructor. Parts layout is not critical but care should be taken to place parts so that neat construction can be done. Keep the oscillator coil and the crystal in one corner and keep the r.f. and mixer coils separated as much as possible to prevent coupling between them. Use good construction practice and you will be proud of this simple converter. This would make a good first building project.

The power needed is 6.3 volts at 0.45 amp. and about 100 volts at 18 ma. This can best be taken from a separate power supply or it can be taken from some receivers. I used a small power supply built on a chassis of the same dimensions as the converter and use a v.r. tube to give me 108 volts.

The converter should be connected to the receiver with coaxial cable, making sure that the input terminal of the receiver is well shielded to prevent feedthrough of signals at the intermediate frequency (i.f.), in other words, the receiver should be capable of being tuned through the entire dial without receiving any signals within the receivers original tuning range with the converter turned off. The feedthrough will cause unwanted heterodynes and annoying squeals when receiving six meter signals.

Changing I.F. Frequency

If you desire to use this converter at some i.f. other than 8 to 12 mc, you can change it by changing the crystal and coils L_3 and L_4. The crystal frequency can be figured by taking the tuning range of the receiver (the low end) from 50 mc. The result is the crystal frequency. Coil L_3 must tune to the crystal frequency while L_4 must tune to the difference frequency or i.f. Higher frequencies will require fewer turns of wire and lower frequencies will require more turns of wire to hit the frequency needed.

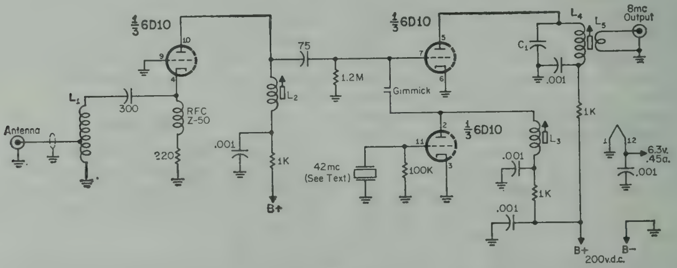


Fig. 1—A simple 6 meter converter using a single 6D10 Compactron. All resistors are ½ watt. All capacitors greater than one are in mmf; others are in mf.

C_1—Less than 47 mmf as needed to resonate L_4.

L_1—11t. #24e. close wound on ⅜" iron core slug tuned form. Tap 3t. from ground end.

L_2—9t. #24e. close wound on ⅜" iron core slug tuned form.

L_3—14t. #24e. close wound on ⅜" iron core slug tuned form.

L_4—Approx. 50t. #30e. close wound on ⅜" iron core slug tuned form, or use CTC ⅜" dia 10 mc coil LS-3.

L_5—6t. #30e. at cold end of L_4.

6 Meter Double Conversion Converter

The unit is built on a compact 3×4×5 inch aluminum minibox. Layout of parts is not critical, but it is essential to keep all connections as short and direct as possible in order to keep stray capacities and inductances from detuning the tank circuits.

Circuit Description

A 6CB6 is used as an r.f. amplifier whose broadbanded tank circuits tune from 50 to 54 mc. The amplified six meter signal is then fed to the grid of the pentode section of a 6U8 where it is heterodyned to 7 mc by the 43 mc signal produced by the triode section of this tube. Then it is capacitively coupled to a 6J6 where it is converted into broadcast frequencies by mixing it with a 6400 kc signal produced by the other section of the 6J6. To avoid drift and tuning problems, the oscillators are crystal controlled.

The tube filaments are shown in the schematic diagram wired for use with a 12 volt battery system. If the unit is to be used in the home station, the power it requires can be obtained from the communications receiver or from the power supply shown in fig. 2.

Alignment

A grid dip meter is essential in the tuning of the converter. A signal generator can also be used, in conjunction with a v.t.v.m. and a receiver, but the procedure becomes painstaking.

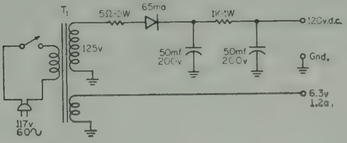


Fig. 2—A simple power supply for fixed station use. If this circuit is used, the filament circuit, shown in fig. 1, must be wired for parallel operation.

Once the wiring has been checked, the tubes and crystals are placed in their respective sockets and power is applied to the unit. When the tubes have warmed up, check for negative voltage at the grids of the oscillator portions of V_2 and V_3 with a v.t.v.m. Tune the grid dipper to 43 mc and, after turning the unit off, couple the grid dipper to L_4. Adjust this coil to minimum current on the g.d.o. Change the frequency to 50.5 mc and couple the dipper to L_1 and L_2, adjusting these coils for minimum dip also. Again change the dipper frequency to 7 mc and tune L_3 in the same way.

As soon as the coils are tuned, the unit is turned on again and is ready for operation. Connect a six meter antenna to J_1, and P_1 to the antenna terminals of a communications receiver. At this point 6 meter signals should be heard by tuning the communications receiver.

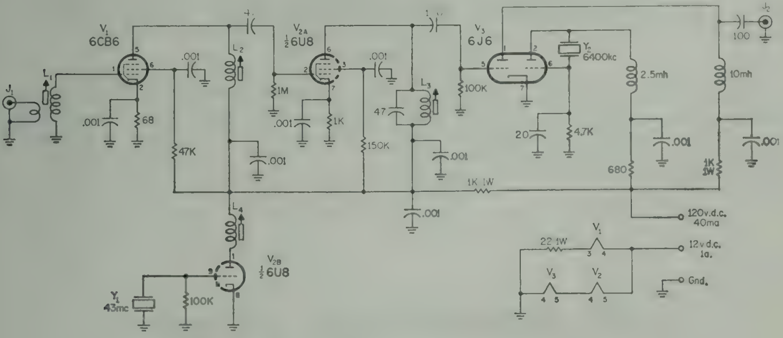


Fig. 1—Circuit of the 6 meter converter with an i.f. output in the broadcast band. All capacitors with values less than one are in mf and are disc ceramics. Values greater than one are in mmf and are tubular ceramics. All resistors are ½ watt unless otherwise noted.

L_1—0.9 to 1.6 mh. with 2 t. #30 en. link. Miller 4403.
L_2—0.9 to 1.6 mh. Miller 4403.
L_3—Same as L_2.
L_4—6.7 to 15 mh. Miller 4406.

Transistor Preamp for 6

Here's another goodie for the tinkerers with a grid dip meter and a 12 volt battery. We can't supply you with too much information at this time, but suffice it to say that the preamplifier shown in fig. 1 has a low noise figure and will provide about 12 db gain. L_1 is made to resonate at 50 mc with a 15 mmf capacitor tapped ⅓ of the length from the grounded end of the coil. The Philco T2028 transistor is readily available through Allied Radio at $4.50. It can be constructed in a small minibox inside the station receiver.

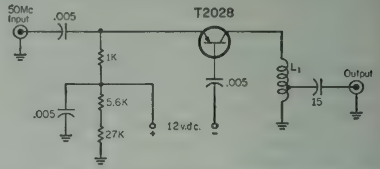
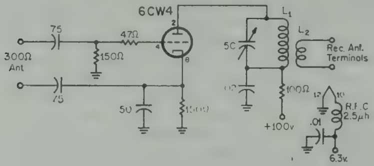


Fig. 1—Simple one transistor 6 meter preamplifier providing 12 db gain. Coil data may be found in the text. All capacitors are in mf unless otherwise stated and all resistors are ½ watt.

Nuvistor Preselector For 6

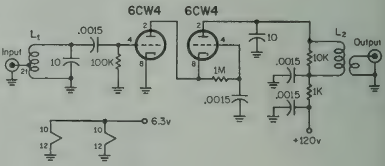
This amplifier uses a nuvistor 6CW4 and will improve the operation of any receiver on 6 meters if the antenna transmission line is 300 ohm ribbon. I have not tried it with coax and it may work as is, without a tuned input circuit.



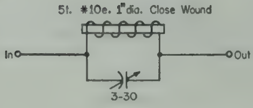
Very simple pre-amplifier for 6 meters. It should be used with a balanced 300 ohm twin lead feeder. By using the same tuned circuit for output and input, and using a 47K resistor from grid to ground, it will make a very fine amplifier. However, input and output sections must be shielded from each other to prevent oscillation.

2 Nuvistor Preselector For 6

Schematic diagram of the 6CW4 Nuvistor preamp for 6-meters built by W8VFT. Although a printed circuit board was used for the original, good results can be had from a conventionally-wired version. Coils L_1 and L_2 are 11 turns #18e. ½" dia. Closewound. Spread turns to adjust tuned circuits to frequency. The output link is two turns of hookup wire on the cold end of L_2.



6 Meter Hash Filter



Generator hash filter for 6 meters. Inserted in series with the generator field and tuned to 50 mc it will effectively suppress most generator noise.

2/6 Meter Converter

Construction was begun by marking the holes to be cut for the sockets and the coils. Using the fiberglass epoxy board makes this a cinch for constructing. Filament wiring and bypassing with the .001 mfd capacitors start the wiring procedure. Next step is to make the ground connections of all tube sockets. The coils can then be wound and put into place. The power supply is the last to be installed. A small transformer was taken from an old television UHF converter that was discarded. The B-plus voltage should be 100 volts coming from the rectifier-filter network.

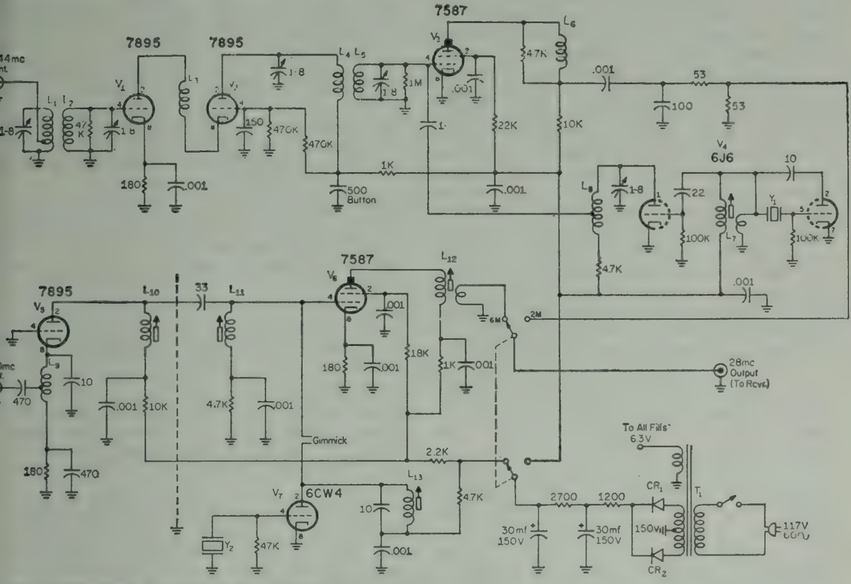


Fig. 1—Schematic diagram of the Nuvistaverter employing the new RCA tetrode nuvistor, the 7587. All variable capacitors marked 1-8 mmf are Erie trimmers, 532B. Gimmick capacitor shown is two 1½" lengths of hookup wire twisted together.

CR_1,CR_2—Selenium rectifiers. Sarkes Tarzian D-45.
L_1—7½t. #16 ¼" dia. 1" long.
L_2—5t. #16 ¼" dia. 1" long.
L_3—4t. #20 ⅛" dia. ¼" long.
L_4—5t. #16 ¼" dia. 1" long.
L_5—4½t. #16 ¼" dia. 1" long.
L_6—25t. #24e. ½" form.
L_7—10t. #24e. ½" form (ceramic) with 1 t. loop.
L_8—6t. #20e. ¼" dia. 1" long.
L_9—10t. tapped 2½ t. from cold end. B&W 3003.
L_{10}—18t. #24e. ¼" form.
L_{11}—16t. #24e. ¼" form.
L_{12}—25t. #24e. ½" form with 2 t. loop.
L_{13}—32t. #24e. ½" ceramic form.
T_1—TV UHF converter type, 110 v. primary, 150 v. secondary with 6 v. filament winding. Stancor PA-8421.
Y_1—38.667 mc third overtone crystal.
Y_2—22.000 mc overtone crystal.

Miniature 2 Meter Receiver

Transistor Q_1 is the detector and is operated in the common base configuration to raise the high frequency gain. Capacitor C_2 feeds back energy from the collector circuit to the emitter and the stage oscillates. However, another *R-C* circuit, consisting of capacitor C_3 and the bias divider components, makes the circuit quench at a high frequency (between 20 and 30 kc). This breaks up the oscillation and creates a sensitive detector action. Coil L_1 and capacitor C_1 are tuned to resonate in the two meter band and couple energy from the antenna to the transistor. Capacitor C_4 eliminates audio degeneration and the shunting capacitor C_5 (with less inductance) acts as an r.f. bypass. Audio output appears across the primary of transformer T_1 (a standard 10K to 2K transistor interstage transformer) and is coupled to the first audio transistor Q_2. Capacitor C_6 filters out the quench voltage while R_4 and R_5 act as bias dividers. Transistor Q_2 acts as an emitter follower to match the input impedance of the audio output stage, Q_3. Note that this stage is connected to drive the speaker voice coil directly. Actually this provides quite enough audio for walkie talkie service where the speaker is close to the ear. If more audio is required the primary of a 500 to 8 ohm (or 3.2 ohm, depending on the type of speaker used) transformer should be connected in place of the speaker. Then you will be able to hear the audio all over the house and in noisy locations.

The 3½ turn coil shown in fig. 1 is correct for the two meter band and would be used in conjunction with a 4.7 mmf capacitor for C_1. The f.m. band can be received by increasing the value of C_1 to 10 mmf. These values will also permit reception of the aircraft band. For six meters increase the number of turns to 6½ and use a 15 mmf capacitor for C_1. For Citizen's Band reception, use a 25 mmf capacitor for C_1 and wind 15 turns of #28 enamel wire on the coil form.

The r.f. choke is not critical and one consisting of 50 turns of very fine enamelled wired on a ½ watt, 1 megohm resistor works well from 27 to 160 mc.

When the construction is completed, you may have to adjust the value of R_5 to produce a total battery current of 30 ma. A value between 3.3K and 5.6K will be required depending on the beta of the 2N1380 transistors. It may also be necessary to increase the value of R_1 if the Texas Instruments 2N2189 is used. The values shown are correct for the 2N1745.

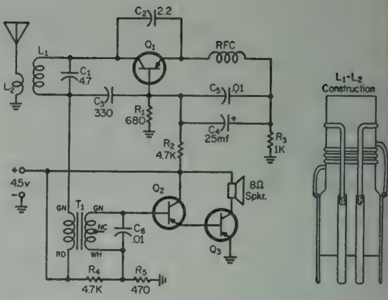


Fig. 1—Circuit of the "Wee-Ceiver," a transistorized 2 meter superregenerative receiver. Coil L_1 and capacitor C_1 as shown tunes 2 meters. See text for other frequencies.

C_1—4.7 mmf. See text.

L_1—3½ t. #22 plastic covered hookup wire on 5/16" dia. coil form. See text.

L_2—1 t. #22 plastic covered hookup wire on same form as L_1.

Q_1—2N1745 or 2N2189.

Q_2, Q_3—2N1380.

T_1—Transistor audio transformer, 10K to 2K c.t. Triad TY-56.

To avoid hand capacitance effects, the receiver should be mounted in a metal chassis box. Note that the antenna link is near the top of the coil form so that the coupling between it and the secondary can be adjusted for best reception.

No-Clobber 2 Meter Converter

During the experimental work on this converter it was found that the unwanted coupling problem was the most serious, from the construction angle. This was solved by copper shields *between and around all stages.* Mechanically the converter can take on many forms. This particular layout follows closely that of W2LVQ , which uses extensive shielding. The judicious use of r.f. chokes as a decoupling medium, augmented by properly placed bypass capacitors, cleared up the last major problem, and the converter began to operate as preliminary theories had predicted.

The 6DS4 Nuvistors are used in the cathode-coupled mixer primarily because of their remote-cutoff characteristics. In addition, two separate tubes provide better isolation and a more stable mixer combination. The local oscillator (known as the Butler Oscillator) was chosen to provide maximum stability and trouble-free operation. This design insures an adequate amount of injection voltage, free of unwanted frequencies. This circuit uses two 6CW4 Nuvistors. The oscillator is essentially a grounded-grid amplifier and a cathode follower with feedback through a crystal connected between the cathodes. Since there is no phase shift through either the amplifier or the cathode follower section, the crystal must operate at series resonance. Oscillator output is doubled in the plate circuit of the second 6CW4 and fed to the grid of the cathode-coupled mixer.

The only critical adjustments of this stage are the values of the cathode resistors, R_2 and R_3. The values of these resistors are reduced to a point where the output is minimum, but still

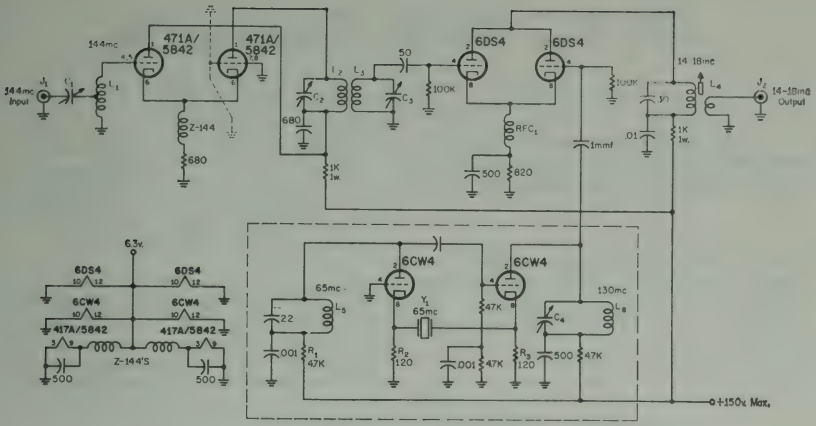


Fig. 1—Circuit of the No-Clobber Converter for 2 meters

C_1—7-45 mmf ceramic trimmer.
C_2, C_3—1-6 mmf tubular ceramic trimmer.
C_4—2-12 mmf ceramic trimmer.
L_1—4 t. #16 silver plated wire, 5/16" dia., ½" l. center-tapped.
L_2—7 t. #16 silver plated wire, ⅜" dia., ⅝" l.
L_3—4 t. #16 silver plated wire, 5/16" dia., ⅜" l.
L_4—22 t. #26 enamel, ⅜" dia., close-wound on slug tuned form. Link—4 t. #22 hookup wire at cold end of L_4.
L_5—6 t. #20 tinned, 5/16" dia., 5/16" l.
L_6—4 t. #16 tinned, 5/16" dia., ⅜" l.
RFC_1—10 t. #24 Formvar, 5/32" dia., closewound.
Y_1—65 Mc. crystal, International type FA-5.

retaining the oscillator's capacity to function at once when the B plus is switched on and off.

This stage requires extreme care in layout so that short direct connections can be made. The oscillator injection voltage may be varied by using a higher value dropping resistor, R_1, in series with coil L_5 in order that adjustments can be made that will not affect the signal-to-noise ratio, rather than the gain.

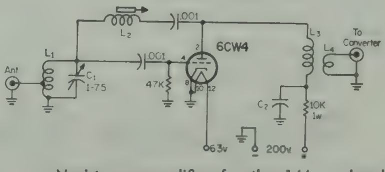
Further Steps

If you are still plagued by overload and cross-modulation the next step is a resonant cavity bandpass filter. This is not a difficult project and will amaze the constructor with its efficiency and ease of construction. However, this is another story and if enough interest is evident another article will be written on this fascinating addition to the solution of common v.h.f. reception problems. This converter worked as well as the six meter version and has provided a new delight in noise free, low distortion reception of two meter signals. The circuit itself and the construction techniques are within the capabilities of any serious minded v.h.f. experimenter and completion of this project will be a welcome addition to any ham shack.

2 Meter Nuvistor Preselector

The tap on the coil L_2, and C_2, should be adjusted for best noise figure. The stage is neutralized by disconnecting the plate voltage and adjusting L_2 for minimum signal feedthrough.

C_1—1-7.5 mmf tubular trimmer.
C_2—.001 mmf button mica.
L_1—6¼t. #18 ¼" dia. ⅝" long.
L_2—Slug tuned coul 0.60 10.0 μh.
L_3—11t. #18 ¼" dia. ¾" long.
L_4—2t. link on L_3.

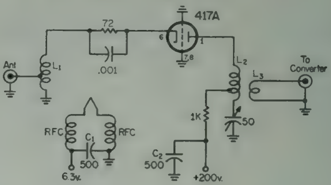


Nuvistor preamplifier for the 144 mc band. For best noise figure, coil L_2 should be adjusted for complete neutralization.

417A 2 Meter Preselector

A favorite 417A circuit in the Carolinas. The tap point and the spacing of L_1 should be adjusted for minimum noise figure.

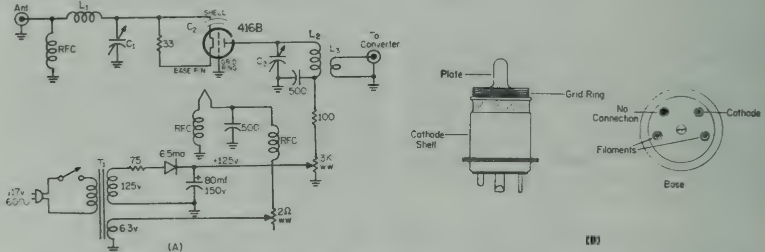
C_1, C_2—500 mmf button standoff type capacitor.
L_1—4½t. #18 ½" dia. ⅝" long. Tap 2½t. from ground.
L_2—8½t. #18 ⅜" dia. ⅞" long. Tap 4t. from plate end.
L_3—2t. hookup wire on cold end of L_2.
RFC—12t. #22 ¼" dia. ½" long.



A 2 meter preamplifier using the popular 417A or 5842 Western Electric triode. No neutralization is necessary if shielding is properly employed. A shield should be placed across the 417A socket to isolate the input and output. The four grid pins may be soldered directly to this shield.

416B 2 Meter Preselector

An outgrowth of the 416B controversy. Brian, W4OAB says "The general consensus of opinion seems to be that blower cooling of a 416B is unnecessary. Plate voltage shouldn't exceed 125 volts and a 2 ohm wirewound pot in the filament lead should reduce the heater current as low as necessary. The lower plate voltage would mean a higher noise figure, but the bias should also be reduced so plate current is about 10 ma. Normal G_m, I understand, is about 50K, but even operation in this manner gives you a G_m in excess of 25K and you don't have to go to 25 ma plate current."



The ultimate in a tube type preamplifier for 144 mc using the gold plated 416B or 6280 planer triode made by Western Electric. The tube normally requires forced air cooling, but if plate and filament currents are limited to low values, no harm will result from convection cooling. Connections to the tube are shown in (B). Note that the r.f. connection to the cathode is made to the outer shell while d.c. connection is made to the cathode base pin. A heat dissipating plate cap should be used to aid in controlling plate dissipation.

C_1, C_3—1-10 mmf piston capacitors.
C_2—Internal capacitance between cathode and 416B shell.
L_1—6t. #20 ¼" dia. ½" long.
L_2—6t. #20 ⅜" dia. ½" long.
L_3—1t. link at cold end of L_2.
RFC—14" #20 e. close wound on ⅛" dia. form.
T_1—Power transformer. 125v. @ 50 ma, 6.3v. @ 2.0a. Stancor PA-8421.

Preselector With Power Supply

Availability of 416-B's can sometimes be a problem since only Western Electric Co. manufactures and uses them. Yet they always seem to be available at swap and shop sessions, etc. Often a friend who works for the phone company can secure used 416-B's for you that will deliver

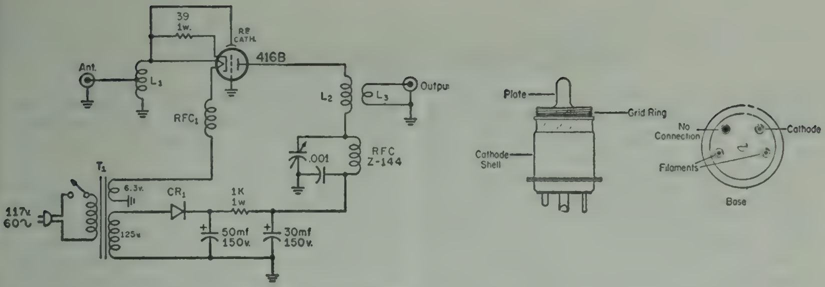


Fig. 1—The "Old Gold" preamplifier for 2 meters, utilizing the conventional 416-B circuitry with a built-in power supply. This version comes from the *VHFer*, and was constructed by W8HHS. Doug claims an increased gain of 22 db over his "barefoot" converter.

CR$_1$—Top hat rectifier, 400 p.i.v.
L$_1$—4 t. #16 wire tapped 1½ t. from cathode, ⅜" dia.
L$_2$—7 t. #16 wire, ½" dia., ¾" long.
L$_3$—2 t. #20 insulated wire in L$_2$.
RFC$_1$—470 ohm, 1 w. resistor, wound full of #30 e. wire.
T$_1$—125 v. 15 ma, 6.3 v. 0.6 a. power transformer. Stancor P-8415.

excellent performance at 144 mc.

The 416-B is designed to be used in grounded grid circuits. They are designed to be used with a 250 v.d.c. plate supply and normally draw about 25 ma. Operating at this power level, forced air cooling is necessary, but you can operate your 416-B with a 125 v.d.c. plate supply and eliminate the need for forced-air.

Plate current at this (125 v.d.c.) voltage is about 5 ma. The filament r.f. choke drops the 6.3 v. filament supply to 5.7 v. This also reduces tube heating, although it does not impair performance.

Allow sufficient air to circulate around the tube through use of ventilated shielding in your chassis enclosure. Perforated aluminum works well. Use a heat dissipating plate connector also. The grid connection on the tube is threaded. This will require a ¾" × 40 thread. A local machine shop turned out eleven of these threaded mounting rings for $3.00. They were made from 1/16" slices of brass stock, threaded on a lathe. The mounts can then be bolted or soldered onto the chassis.

Connections to the tube base pins can be made by pulling pins from a 7 or 9 pin miniature tube socket and using them for filament and cathode connectors. Easy? Yes! Beyond that, however, use conventional v.h.f. layout techniques (short, direct, well-soldered leads and quality components.

For DX work this preamp will serve you well. Noise figures on the one originally constructed was about 3.8 db. Overall gain over the "barefoot" converter measured 22 db. Other models of this circuit, build locally, gave similar results.

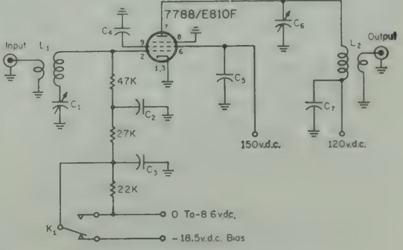
Make sure your coax relay doesn't allow high signal leakage to the preamp when transmitting. It could damage the 416-B.

Tune-up is simple: Tune the plate circuit for peak received signal on a weak station and adjust the position of the L_1 tap for best noise figure.

7788 2 Meter Preselector

Two meter preamp using the new Amperex 7788/E810F pentode. Relay contacts K_1 may be extra contacts on the station antenna relay and are used to prevent overload and damage to the tube by the transmitter's r.f.

L$_1$—7t. #18, ¼" dia. spaced 1 wire dia. with 2 turn link of hookup wire at cold end.
L$_2$—5t. #18, ¼" dia. spaced 1 wire dia. with 1½ t. link of hookup wire at cold end.
C$_1$—2-9 mmf variable. Johnson 160-104.
C$_2$, C$_3$, C$_4$, C$_5$, C$_7$—0.001 mf button micas.
C$_6$—3-11 mmf variable. Johnson 160-107.



430 mc Converter

The mixer i.f. output drives a 6AB4 cathode follower, providing low noise gain as well as low impedance i.f. output. This stage may not be an absolute necessity but it reduces the noise figure requirement of the receiver used for the i.f. channel. It also reduces the birdie problem by isolating the receiver from the mixer. Inductor L_5 forms an *L* section with the tube input capacity to give an impedance (and voltage) step-up. The purpose of L_4 is to tune out the reactance of C_7 as well as to provide a d.c. return for the diode mixer. Inductor L_6 is a neutralizing coil which resonates with the 6AB4 cathode-to-grid capacity. If the stage is not neutralized, instability may occur whenever the output is terminated in a capacitive load.

The i.f. output frequency of 14 mc requires local oscillator injection at 418 mc. This is supplied by the 12AT7 and 6AK5 in conventional oscillator-multiplier circuit. I used a 46.5 mc crystal, but a 15.5 mc crystal working on its third overtone will work as well. A 11.67 mc crystal working on its third overtone will also work provided L_7 is changed so as to resonate at 35 mc. In any case the 12AT7 will

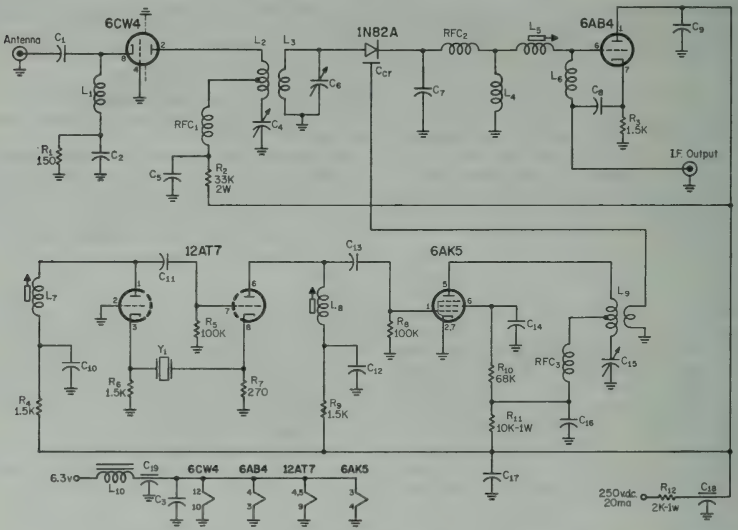


Fig. 1—Circuit of the 432 mc converter with an i.f. output of 14 mc. Details of the 6CW4 shield is shown in fig 2 and Ccr is described in the text.

C_1—50 mmf tubular ceramic.
C_2, C_3, C_5—500 mmf button bypass.
C_4, C_{15}—0.5-5 mmf piston type variable.
C_6—5 mmf miniature variable, Johnson 5M11 or equivalent.
C_7—25 mmf mica.
C_8, C_9—.01 mf ceramic.
C_{10}, C_{12}—.001 mf ceramic.
C_{11}, C_{13}, C_{14}, C_{16}, C_{17}—56 mmf disc ceramic.
C_{18}, C_{19}—.001 mf feed through bypass.
L_1—3 turns #20 E., 3/16" dia., 5/16" long.
L_2—1 2/3 turns #18 E., 7/16" dia., center-tapped.
L_3—½ turn loop #16 E., 7/16" dia.
L_4—6 microhenries. 41 turns #26 d.c.c. scramble wound on a 1 meg, ½ watt resistor.
L_5—37 turns #30 E. close wound, ½" slug tuned form.
L_6—26 microhenries, 85 turns #30 d.c.c. scramble wound on a 1 meg, ½ watt resistor.
L_7—9 turns #22 E. closewound on ⅜" dia. slug tuned form.
L_8—4½ turns #20 E. 5/16" long on a ¼" dia. slug tuned form.
L_9—2½ turns #20 E. ¼" dia., ¼" long, air wound, center-tapped. 1 turn link.
L_{10}—28 turns #30 E. closewound on a ⅜" dia. powdered iron slug.
RFC_1, RFC_2, RFC_3—8 turns #26 E. 3/16" dia, ⅜" long, air wound.
Y_1—46.5 mc (See Text).

give enough drive at 139 mc for the 6AK5 tripler. The very small amount of 418 mc power required by the mixer is coupled-in by means of a stiff wire running from the link of L_9 to the vicinity of the mixer diode. Spacing between the wire and the diode is adjusted to give about 0.3 ma of crystal current.

The entire converter is built on a 5×7×2 inch chassis without crowding. The photographs give the general parts layout. Power supply leads are filtered by C_{18}, C_{19}, L_{10}, and R_{12}. These components are mounted as close to the power connector as possible, and the feed through bypass capacitors C_{18} and C_{19} are mounted on a small bracket as shown in the photograph. Possibly less filtering would be adequate, but signals in the 20 meter region become extremely strong at times and it is best to stop them before they have a chance to get on the i.f. stage grid. A removable chassis bottom plate is used for the same reason. No trouble has been experienced with i.f. signals leaking through the r.f. stage.

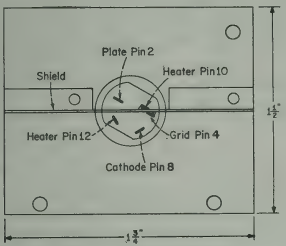


Fig. 2—Layout of 6CW4 Nuvistor r.f. amplifier. Pins 10 and 4 are soldered directly to the vertical shield.

The r.f. stage is constructed as a subassembly and then fastened to the chassis. A regular Cinch Nuvistor socket is mounted by soldering to a 1½ by 1¾ inch piece of flashing copper. The two ears on the socket mounting ring are broken off so that the ring can be brought flush with the copper. The shield may be made of tin can metal (tin plated on both sides) and should be as tight fitting around the socket as possible. Pins 4 and 10 are soldered directly to the shield.

First step in alignment is to get the 12AT7 Butler oscillator working properly. This is best done by listening to the crystal frequency (or harmonic thereof) with a receiver. With the 12AT7 and 6AK5 tubes in their sockets, apply heater and plate voltage. Set L_7 to a point that gives strong output and permits easy oscillator starting. Inductor L_8 can be peaked for maximum grid current in R_8. Insert a 0-1 ma meter in the ground lead of L_4 and tune C_{15} for maximum crystal current. You may want to incorporate a closed circuit jack at this point for easier checking of crystal current.

Next, insert the 6AB4 in its socket and connect the converter to your receiver, using shielded cable for the i.f. signal. You should now be able to tune in a strong 432 mc signal, such as the third harmonic of your two meter transmitter. Peak C_6 and L_5 for maximum S-meter reading. Then adjust the local oscillator injection to give about 0.3 ma rectified crystal current.

With a well matched 432 mc antenna connected, plug in the 6CW4 and peak C_4 for maximum sensitivity. If r.f. stage instability is noticed, increase the coupling to the mixer by pushing L_2 closer to L_3. When the antenna is removed, the r.f. stage will oscillate, this usually being characterized by an increase in noise output. Replacing the antenna should stop the oscillation. If it doesn't, further increase the coupling between L_2 and L_3. The optimum degree of coupling is slightly more than the minimum that will prevent instability with the antenna connected. As a last resort to cure r.f. stage instability, the value of R_1 may be increased. This, however, will somewhat degrade the noise figure and should not be necessary if the r.f. stage is properly constructed.

The overall noise figure as measured with W6NLZ's noise generator is 5.1 db. Judging by on the air performance and comparison with a parametric amplifier, this measurement seems reasonably accurate.

430 mc Transistor Preselector

The circuit is very simple as a glance at fig. 1 will show. It is basically a grounded base configuration and R_1, R_2 and R_3 are the biasing

C_1—470 mmf disc ceramic.
C_2—1500 mmf u.h.f. bypass feedthrough. Erie type 357.
C_3—1000 mmf u.h.f. bypass. Sprague type 507C.
C_4—0.7-3 mmf plastic dielectric piston trimmer. Erie 535C, Part #535-OR7.
L_1—3T #20, ¼" i.d. ¾" long, tapped 1 turn from the transistor end.

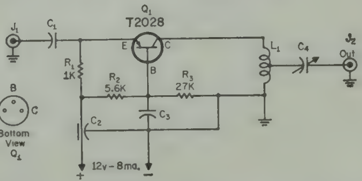


Fig. 1—Circuit of the 420 mc transistorized preamplifier. All resistors are ½ watt.

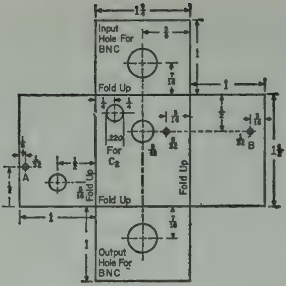


Fig. 2—Chassis layout for the 432 mc preamplifier. Material used should be 1/32" brass or copper. Hole (A) on the left flange is for grounding L_1, and (B) on the right flange is for grounding R_3.

network, C_2 and C_3 are r.f. bypasses while C_1 and C_4 are blocking capacitors. Capacitor C_4 also serves to tune L_1.

Layout the chassis as shown in fig. 2. Punch, fold and solder the seams closed. Mount the input and output jacks and fasten C_2 and C_3 to the chassis. Solder in R_1, R_2, R_3 and C_1, keeping all the leads short. Position all the parts as shown in the photographs. Now solder in C_4 the output tuning capacitor.

The unit is now ready for the transistor. Cut the leads to a 3/16" length. Slip the transistor through the 5/16" hole and fasten the hold-down clamp into position as shown in fig. 3. Use a good heat sink when soldering the leads. First wire the base, then the emitter and last the collector when the coil is added.

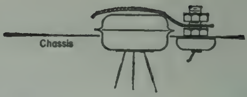


Fig. 3—Details of the transistor mounting. A small copper flange cut from the 1/32" chassis stock mounts on the C_2 stud to hold the transistor down.

Installation and Adjustment

Adjustment of this amplifier is made by placing the unit in the leadin wire, applying + 12 v.d.c. to C_2, setting the receiver to the center of the 420 mc band and tuning C_4 for a peak in signal level.

This unit lends itself to antenna mounting since C_4 blocks d.c. from L_1. A small 420 mc r.f.c. may be added to the circuit to enable feeding the +12 volts through the coax line. This choke should have zero lead length at the jack end. The simplified circuit for choke wiring is shown in fig. 4.

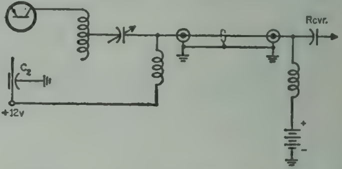


Fig. 4—Circuit used for feeding power when the preamp is mounted at the antenna. The 432 mc chokes are mounted directly at each connector and the d.c. leads run the necessary lengths.

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